Chapter 10: Energy Element

10.1 Vision Statement

"The Energy Element of the Comprehensive Plan serves to identify the energy infrastructure within our county and promote energy conservation measures that benefit our communities"

In developing a comprehensive community approach to energy conservation, it is essential to examine energy consumption at the local level. As an inventory of existing conditions, this section examines the diversity, availability and affordability of energy sources; the level of local dependence on these sources; and the associated economic and environmental considerations. This analysis allows the identification of significant community issues associated with energy conservation to facilitate the development of goals and objectives for the energy element.

To assess energy use, it is important to understand how energy is measured. Electricity is commonly measured in watts and watt-hours. While watts describe the rate at which energy is being consumed or produced at a given moment, watt-hours measure the total amount of energy consumed or produced over time. A kilowatt is equal to 1,000 watts and is used to describe the power use of appliances such as refrigerators and water heaters. One kilowatt hour (kWh) is 1,000 watts consumed or produced in one hour. Measuring the output of power plants requires larger measuring units such as the megawatt (equal to one million watts) and the gigawatt (equal to 1,000 megawatts).

Natural gas is measured either by volume (cubic feet) or by heat content (therms). When measured in terms of cubic feet, larger volumes of natural gas are measured in hundreds of cubic feet (Ccf) or thousands of cubic feet (Mcf). Natural gas companies have begun to switch to therms as the standard measurement because heat content is a more accurate way of quantifying amounts of natural gas. A therm is defined as 100,000 British thermal units (Btu).

To compare or add the energy consumed or produced by different energy sources, it is useful to convert to the energy industry's common unit, the Btu. One Btu represents the amount of energy required to increase the temperature of one pound of water (one pint) by one degree Fahrenheit. Because Btu measurement can be very large when discussing county-wide energy use, one million Btu (MMBtu) will be the common unit of measurement referenced throughout this document. Appendix B includes a listing of relevant energy conversion factors.

The concept of energy measurement can be difficult to grasp without comparisons to energy use in our everyday lives. Such estimates of energy usage have been developed by the US Energy Information Administration (EIA) to help bring energy measurements into a practical perspective. According to the EIA, the average single-family home (2.5 persons) in the United States uses approximately 108 MMBtu per year, while the average automobile consumes almost 69 MMBtu per year. Annual per capita energy use nationwide is estimated to be 326.5 MMBtu.

10.2 State and National Energy Use Overview

The United States was self-sufficient in terms of energy until the late 1950s when energy consumption began to outpace domestic production. Since the late 1950s, the nation has imported more energy than it exported. According to the EIA, in 2009 the United States imported 22.8 quadrillion Btu (a decrease of 8.8% since 2000) and exported 6.93 quadrillion Btu of energy (a 73% increase since 2000).

Petroleum has dominated energy imports since 1994, with the country importing more petroleum than it produces. Energy use by the national transportation sector relies overwhelmingly on petroleum, growing by more than 45% from 1973 to 2009. Motor gasoline accounts for two-thirds of the petroleum consumed in this sector, along with distillate fuel oil (diesel engine fuel) and jet fuel.

Most domestic energy is derived from fossil fuels. Renewable energy resources, primarily hydroelectricity and the industrial use of biomass, have supplied a relatively small but steady energy source. Renewable energy production nationwide has increased by more than 75% since 1973, from only 7% of all energy

production to 10.6% of all energy produced. In the late 1950s, nuclear fuel began to be used to generate electricity, and, by the late 1980s, nuclear energy contributed about the same share as renewable energy. In the late 1990s, nuclear energy production surpassed renewable energy production – a trend that continued through 2009.

As the State's economy has grown, so too has its energy needs, with statewide energy consumption rising at a much higher rate than the United States average over the past three decades. South Carolina ranked 19th highest in the nation in total per capita energy consumption. Total statewide energy consumption rose by 173% between 1979 and 2008, compared with an increase of only 22.8% nationwide during the same period. However, after decades of rising energy consumption that peaked in 2005 at 1,202.8 trillion Btu, energy consumption in South Carolina has decreased each succeeding year to a five-year low of 1,659.5 trillion Btu in 2008.

South Carolinians have long enjoyed energy on demand at some of the lower prices in the nation. In 2008, energy prices in the State ranked 25th lowest nationwide – 4.4% lower than the national average. However, residential electricity consumption in the State exceeds the national average, resulting in average household utility bills that exceed the national average by more than 12.4%.

With four active nuclear power plants, South Carolina is among the top nuclear power producers in the nation. Nuclear energy now accounts for more than half (52.9%) of the State's energy generation. Consumption of nuclear energy in South Carolina rose by more than 25% from 1988 to 2008. The State ranks third in the nation – behind only Pennsylvania and Illinois – in both nuclear energy generation and consumption. Two additional nuclear reactors could come online in the State by 2016 if licensing and construction proceed as planned.

Petroleum consumption accounts for 32.9% of the State's energy use, nuclear electric power for 32.6%, and coal for 26.8% of statewide energy use. Natural gas comprises only 10.6% of energy use statewide. End-use deliveries of natural gas in South Carolina were 3.8% higher in 2008 than in 2004. The increase occurred primarily in the generation of electric power, where natural gas deliveries increased by 47.6%. The industrial sector is the primary consumer of natural gas in the State, comprising 42.9% of all natural gas deliveries in 2008, as compared to 31.1% nationwide. Renewable energy accounts for 6.5% of the State's energy consumption.

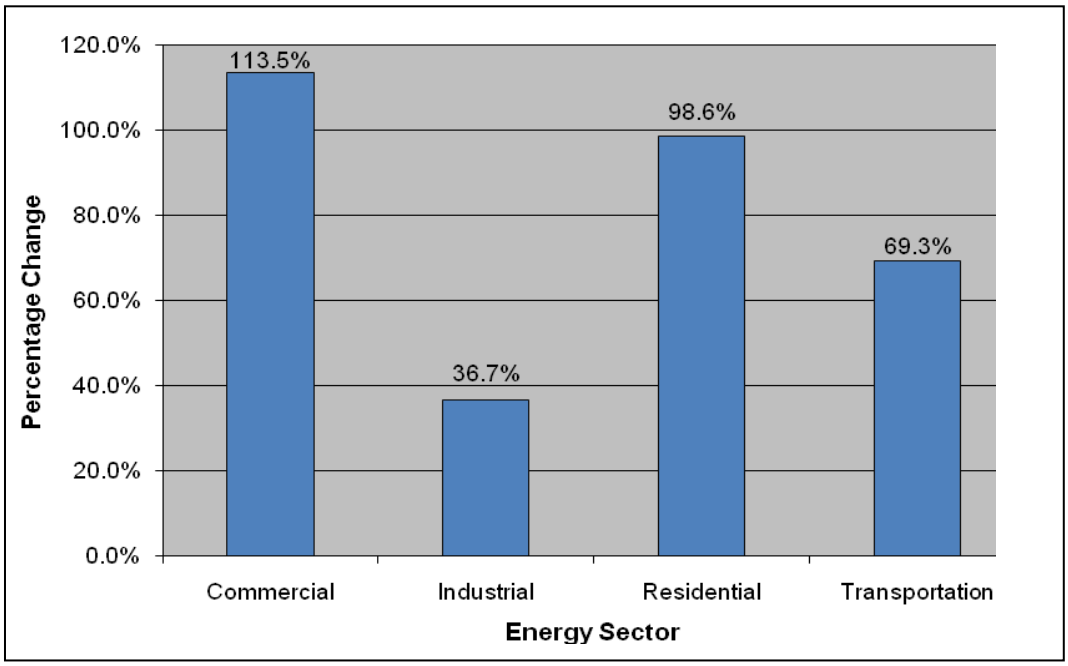
The industrial sector accounts for 35.3% of energy consumption in South Carolina. This sector includes manufacturing industries, mining companies, construction companies, and agricultural, fishery and forestry operations in the industrial sector. Energy use in the transportation sector, including all private and public vehicles that move people and commodities, comprises nearly 27% of statewide consumption. The residential sector includes all private residences whether occupied or vacant, owned or rented and accounts for 21.8% of the State's energy consumption. The remaining 16% of energy is consumed by the broadly defined commercial sector, which consists primarily of hotels, motels, restaurants, wholesale businesses, retail stores, laundries and other service enterprises, as well as religious and nonprofit organizations.

Electricity accounts for more than two-thirds (70.7%) of residential energy consumption in South Carolina, but only 41.1% on the national level. Nearly one-fifth (19.5%) of residential energy is provided by natural gas, much lower than the 43.6% of residential energy nationwide provided by natural gas. Electricity provides 69.5% of energy used in the commercial sector in South Carolina, as compared with 53% in the United States. As in the residential sector, natural gas comprises 21.6% of commercial consumption statewide, while the national rate is higher at 37.4%.

From 1979 to 2008, energy consumption in the State's commercial sector increased by 113.5%, while industrial energy use rose by 36.7% (*Figure 10-1*). Residential energy consumption increased by 98.6% and transportation use by 69.3% during the same time period. Unlike the residential and commercial sectors that rely primarily on electricity for energy, energy consumption in the industrial sector is more diversified.

South Carolina ranks 17th nationally in industrial energy consumption. Nearly 27% of industrial energy is provided by electricity, 27.3% by petroleum, 20.1% by natural gas, 17.6% by wood and waste biomass, and 8% by coal.

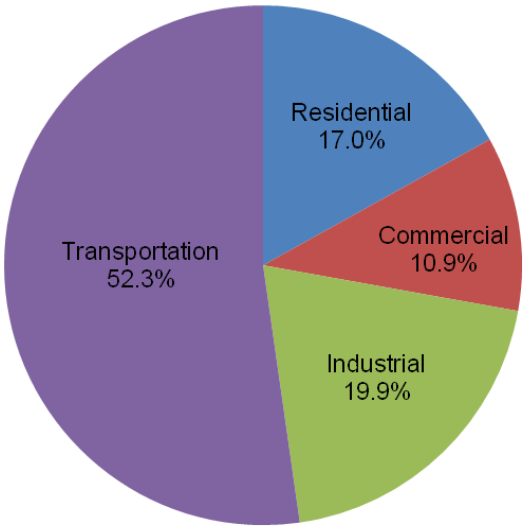
Figure 10-1. Increase in Energy Consumption by Sector, 1979 - 2008
South Carolina



Source: EIA State Energy Data System, 2010.

Electric prices in South Carolina are slightly below the national average. Energy expenditures statewide have risen by 462.4% since 1979, while energy consumption increased by nearly 62% during the same period. South Carolinians spent $21.4 billion on energy in 2008. The transportation sector is responsible for the largest share of energy expenditures at 52.3%, followed by the industrial sector at 19.9%, the residential sector at 17% and the commercial sector at 10.9% *(Figure 10-2)*.

Figure 10-2. Share of Energy Expenditures by Sector in South Carolina, 2008



Source: EIA State Energy Data System, 2010.

While events such as energy supply disruptions or political turmoil can affect energy prices in the short term, long-term trends are primarily influenced by fundamental issues including the availability of energy resources, emerging technologies, changes in domestic policies and regulations, developments in domestic electricity markets, and the impact of economic growth on projected energy demand. In its *Annual Energy Outlook 2010*, the EIA reports that US energy markets continue to show the impacts of the economic downturn that began in late 2007 and has continued well into 2010. Total electricity generation fell by 1% in 2008 and dropped by another 3% in 2009 – the first instance in the 60-year data series maintained by the EIA that electricity use has fallen for two consecutive years. Energy consumption per person has also declined sharply to a 2009 level of 310 MMBtu per person, the lowest since 1968. Key factors expected to influence US energy markets in the next few years include the pace of the economic recovery, financial market impacts on capital-intensive energy projects, and the potential enactment of additional legislation related to energy and the environment.

Annual average crude oil prices increased six-fold from 1999 to 2008, from $15.56 per barrel to $94.04 – the highest annual average domestic first purchase (wellhead) price recorded by the EIA. While the average annual crude oil price fell by 40% to a four-year low of $56.35 in 2009, monthly prices rose steadily and continued to rise throughout the first quarter of 2010. Because crude oil is refined into petroleum products used for gasoline, diesel fuel, home heating oil, liquid petroleum gases, propane, jet fuel, and as a raw material to create products – such as plastics, polyurethane, solvents, and asphalt – crude oil prices directly impact the cost of transportation, home heating, manufacturing and electric power generation. One 42-gallon barrel of crude oil provides approximately 44 gallons of petroleum products. While crude oil prices are determined by worldwide supply and demand, additional factors include the US and worldwide economy, OPEC oil production limits, and government regulation. Additional unforeseen factors include hurricanes, government instability and military actions in oil producing regions, and disruptions caused by major accidents such as the explosion at the BP Deepwater Horizon well in the Gulf in 2010. The EIA projects that despite the recent economic downturn and efforts by many countries to limit access to oil resources in their territories, growing demand for energy – particularly in China, India, and other developing nations – will lead to rising oil prices over the long term. Oil prices are expected to rise slowly as global economic growth leads to higher global oil demand, growth in non-OPEC oil supply slows, and members of OPEC continue to support higher oil prices.

Average annual retail motor gasoline prices nearly tripled from 1999 to 2008, from 122.1 cents per gallon (including taxes) to 331.7 cents per gallon, and then fell by more than 27% to 240.1 cents per gallon in 2009. However, motor gasoline prices increased steadily during the first half of 2010. Factors influencing retail gas prices include the cost of crude oil, refining costs and profits, distribution and marketing costs and profits, and Federal, state and local taxes. The largest factor impacting the price of gasoline is the cost of crude oil. Rapid growth in demand for gasoline in recent years fueled soaring gasoline prices that reached record levels in mid-2008. By the fall of 2008, crude oil prices began to fall due to the weakening economy and collapse of global petroleum demand, causing gasoline prices to drop to a 3-year low in early 2009. In the short-term, the EIA expects higher crude oil prices to combine with refiner margins to boost annual average motor gasoline prices. While it is difficult to make accurate long-range predictions about future gasoline prices given the number of frequently changing factors involved, several factors will increase the likelihood that fuel prices will continue to fluctuate well into the future including: dependence on imported supplies, increased government support for the development and use of biofuels; and increased interest in alternative fuel (electric, hybrid and natural gas) vehicles.

Between 1999 and 2008, the average annual wellhead price (the value at the mouth of the well) of natural gas more than tripled, from $2.19 per thousand cubic feet (Mcf) to $7.96 per Mcf. However, natural gas prices fell to their lowest level in 7 years to $3.71 Mcf in 2009. Factors that contributed to this decline included the weakened economy, reduced heating demand due to a warmer than normal winter, and higher than usual production and storage levels. The EIA projects that average natural gas prices will generally increase, as higher cost resources are brought on line to meet growth in demand. Uncertainty surround the long-term trend in natural gas prices, given questions related to the size of the shale gas resource base (typically more difficult and costly to extract), the price level required to sustain its development, and whether there are technical or environmental factors that might hamper its development.

The average annual retail price of electricity in the US nearly doubled from 1999 to 2008, from 6.64 cents per Kilowatt hour (kWh) to 9.94 cents per kWh. Electricity prices have continued to rise, reaching 9.89 cents per kWh in 2009 and steadily increasing throughout the first half of 2010. Electricity prices are based on generation, transmission and distribution costs. Fuel costs account for most of the generation costs for natural gas and oil-fired plants, but much less for coal and nuclear plants. Because the EIA projects natural gas fired generation to increase in the coming years, projected increases in natural gas prices are expected to have the greatest impact on electricity prices. Transmission costs are also expected to rise as new infrastructure is built. Average annual electricity prices are projected to fall slightly in the near term due to a drop in fossil fuel prices and a lower demand that coincides with the startup of new renewable, natural gas and coal-fired capacity. Prices are projected to rise in the long-term in response to rising fuel prices and the construction of new power plants to accommodate demand.

10.3 Inventory of Local Energy Sources and Costs

A key component in an effective and relevant energy conservation plan is a comprehensive assessment of the energy sources used in Greenwood County as well as the costs associated with these uses. Factors such as the diversity of energy sources, energy source use within economic sectors, and the geographic origin of local energy supplies provide baseline information that can be used both to analyze current conditions and to make projections of future energy use. An examination of local dependence on nonrenewable resources and the possible adverse affects of some energy sources will provide greater insight into future avenues for energy conservation in Greenwood County. While more recent local energy data is not available at this time, an energy analysis can be conducted and updated once such data is made available. It should be noted that H.D. Payne and Company is now the sole distributor of fuel oil and Stockman Oil is the only distributor of kerosene in Greenwood County. However, to maintain data consistency and integrity, data from 2001 providers was included in this analysis and will be updated as more recent energy data becomes available.

10.3.1 Energy Supply Mix and Cost

Data obtained in 2001 from Greenwood County energy providers – including the Greenwood Commissioners of Public Works (GWCPW), Duke Power Company, Little River Electric Cooperative, Greenwood Petroleum and Stockman Oil – indicates energy customers in Greenwood County consume more than 9.7 million MMBtu per year, excluding transportation fuels. Nearly 58% of the energy distributed in Greenwood County comes from electricity, at a cost of more than $73 million a year. The bulk of the remainder of the energy distributed within the County (42%) comes from natural gas, at a cost of more than $30.7 million. Energy in the form of fuel oil and kerosene represent small shares of the County energy market. Greenwood County consumers spend more than $104 million annually on energy. Fuel costs average $10.74 per MMBtu. The costliest energy type is electricity at $13.03 per MMBtu. Kerosene follows at $10.24 per MMBtu and fuel oil at $8.15 per MMBtu. Natural gas is Greenwood County's least costly energy source at only $7.60 per MMBtu.

Figure 10-3. Total Energy Distribution by Energy Type in Greenwood County, 2001

Energy Type	MMBtu	% Total MMBtu	Total Cost	Cost per MMBtu
Electricity	5,626,166.2	57.9%	$73,281,935	$13.03
Natural Gas	4,042,145.4	41.6%	$30,701,662	$7.60
Fuel Oil	38,125.9	0.4%	$310,820	$8.15
Kerosene	11,697.9	0.1%	$119,750	$10.24
Total	**9,718,135.4**	**100.0%**	**$104,414,167**	**$10.74**

10.3.1.1 Residential

Consumers in Greenwood County's residential sector use 2.27 million MMBtu of energy each year. Much of this energy is in the form of electricity, accounting for nearly 60% of total energy distribution. Natural gas provides much of the remainder of energy for residential consumers at 39%, with fuel oil and kerosene each providing less than 1% of total residential energy.

In 2001, residential customers in Greenwood County paid $14.82 per MMBtu for energy of all types, with a total energy cost of more than $33.6 million per year. Electricity is the most expensive energy source for residential customers at $16.95 per MMBtu, with a total annual cost of more than $23 million.

Consumers in the residential sector paid $11.74 per MMBtu for natural gas at a total cost of more than $10.3 million annually. Cost per MMBtu in the residential sector is lower for fuel oil and kerosene, at $8.65 and $10.28, respectively.

Figure 10-4. Residential Energy Distribution by Energy Type in Greenwood County, 2001

Energy Type	MMBtu	% Total MMBtu	Cost	Cost per MMBtu
Electricity	1,357,689.6	59.8%	$23,010,288	$16.95
Natural Gas	885,530.1	39.0%	$10,393,296	$11.74
Fuel Oil	15,852.3	0.7%	$137,160	$8.65
Kerosene	11,157.9	0.5%	$114,750	$10.28
Total	**2,270,229.9**	**100.0%**	**$33,655,494**	**$14.82**

10.3.1.2 Commercial

Nearly 1.4 million MMBtu of energy is used by the commercial sector in Greenwood County annually. The County's commercial sector also includes agricultural and institutional (government and schools) energy uses. More than half of this energy (51.6%) comes from electricity and 47% from natural gas. Fuel oil accounts for 1% of energy and kerosene provides a very small fraction (only 540 MMBtu) of energy in the commercial sector.

Commercial energy consumers pay $13.60 per MMBtu in Greenwood County, with a total energy cost of more than $18.9 million a year. Electricity is the most expensive source at $16.72 per MMBtu, with a total cost per year of more than $12 million. Commercial customers pay $10.31 per MMBtu for natural gas, with a total per year cost of nearly $6.8 million. Only $5,000 is spent on kerosene in the commercial sector yearly, at a cost of $9.26 per MMBtu. Fuel oil is the least expensive energy source at only $7.93 per MMBtu, with a total of $110,660 spent annually.

Figure 10-5. Commercial Energy Distribution by Energy Type in Greenwood County, 2001

Energy Type	MMBtu	% Total MMBtu	Cost	Cost per MMBtu
Electricity	718,435.7	51.6%	$12,014,625	$16.72
Natural Gas	658,787.0	47.3%	$6,794,009	$10.31
Fuel Oil	13,952.2	1.0%	$110,660	$7.93
Kerosene	540.0	0.0%	$5,000	$9.26
Total	**1,391,714.9**	**100.0%**	**$18,924,294**	**$13.60**

10.3.1.3 Industrial

More than 6 million MMBtu of energy is used by Greenwood industrial consumers each year. Nearly 59% of this industrial energy comes from electricity, while 41.2% is generated by natural gas. Only 8,321 MMBtu of energy is generated by fuel oil in the industrial sector and no kerosene is used for industrial purposes in the County.

Greenwood County industrial consumers expend an average of $8.56 per MMBtu, with a total energy cost of more than $51.8 million a year. Electricity is the most costly energy source for industrial customers at $10.78 per MMBtu, with a total cost of more than $38.2 million annually. Natural gas customers pay $5.41 per MMBtu, with a yearly cost of more than $13.5 million. The small percentage of customers (less than 1%) using fuel oil pay $7.57 per MMBtu.

It is important to note that due to larger quantities used, industrial energy consumers in Greenwood County pay substantially less per MMBtu for energy than residential and commercial customers. Overall energy costs were $5 or more per MMBtu for residential and commercial customers and more than $6 for residential and commercial electricity customers. Natural gas consumers in the industrial sector pay $6.33 less than residential consumers and $4.90 less than consumers in the commercial sector.

Figure 10-6. Industrial Energy Distribution by Energy Type in Greenwood County, 2001

Energy Type	MMBtu	% Total MMBtu	Cost	Cost per MMBtu
Electricity	3,550,041.1	58.6%	$38,257,022	$10.78
Natural Gas	2,497,828.3	41.2%	$13,514,357	$5.41
Fuel Oil	8,321.4	0.1%	$63,000	$7.57
Kerosene	0.0	0.0%	$0	$0.00
Total	**6,056,190.8**	**100.0%**	**$51,834,379**	**$8.56**

10.3.2 Energy Sources

The Greenwood Commissioners of Public Works (CPW) provides electricity to customers within the City of Greenwood. Duke Energy is the primary electricity provider for the unincorporated area of Greenwood County outside of the City of Greenwood, with Little River Electric Cooperative distributing electricity to customers in limited areas along the Greenwood and Abbeville County border.

Nearly 84% of the total electricity distributed in Greenwood County in 2001 was from Duke Energy. Greenwood CPW provided more than 16% of the electricity in the County, with the remainder (less than 1%) provided by the Little River Electric Cooperative. Greenwood CPW also provided natural gas to all Greenwood County consumers. Greenwood Petroleum provided 78% of all kerosene and all fuel oil distributed in Greenwood County, while Stockman Oil provided 22% of the kerosene sold in the County in 2001.

Figure 10-7. Energy Distribution by Energy Type and Provider, 2001
Greenwood County

Source/Provider	MMBtu	% of MMBtu
Electricity	5,626,166.2	57.9%
Duke Power	*4,703,714.8*	*83.6%*
Greenwood CPW	*922,252.7*	*16.4%*
Little River	*198.7*	*0.0%*
Natural Gas	4,042,145.4	41.6%
Greenwood CPW	*4,042,145.4*	*100.0%*
Fuel Oil	38,125.9	0.4%
Greenwood Petroleum	*38,125.9*	*100.0%*
Kerosene	11,697.9	0.1%
Greenwood Petroleum	*9,180.0*	*78.5%*
Stockman Oil	*2,517.9*	*21.5%*
Total	**9,718,135.4**	**100.0%**

10.3.2.1 Electricity

The City of Greenwood established the ***Greenwood Commissioners of Public Works*** (CPW) in 1896 to provide electrical and water service to City residents. CPW is publicly owned and is governed by a three member Board of Commissioners. The Greenwood CPW Electric Distribution System provides power to more than 12,000 customers. The System includes 5 substations and approximately 180 miles of line. Greenwood CPW purchases electricity from two sources – Duke Energy and the Southeastern Power Administration. CPW obtains the majority of its energy (approximately 95%) from Duke Energy and the remainder from the Southeastern Power Administration.

As part of the US Department of Energy, the ***Southeastern Power Administration*** markets electric power and energy generated by US Army Corps of Engineers reservoir projects (hydroelectric) to public bodies and cooperatives in the states of West Virginia, Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Tennessee, and Kentucky. Their customers include 198 electric cooperatives and 292 public bodies, ultimately serving 12 million retail customers. The total generating capacity of the Southeastern Power Administration is 3,392 megawatts.

Duke Energy is an investor-owned utility that serves approximately 2.4 million customers within their 22,000 square mile service area in central and western North Carolina and South Carolina. More than one-fourth (600,000) of Duke Energy's customers are in South Carolina. The Company operates 14 coal-fired stations, 3 nuclear stations, 30 hydroelectric stations, and numerous turbine units fueled by natural gas or fuel oil. Approximately half of Duke Energy's electricity is generated nuclear energy, with the remainder produced by coal, oil, gas-fired and hydro-electric power plants. Duke Energy produces much of the electricity for Greenwood County at its Oconee Nuclear Station, located on the shores of Lake Keowee in Oconee County. The Oconee Station operates 3 units with a total capacity of 2,538 megawatts. Electricity for Greenwood County customers is also produced at the Buzzard Roost Plant in Greenwood County. The Buzzard Roost Plant operates 10 combustion turbine (gas) units, with a total capacity of 196 megawatts.

The ***Little River Electric Cooperative*** is a member-owned rural electric cooperative based in the nearby City of Abbeville. Founded in 1940, Little River provides service to more than 13,000 residential, commercial and industrial customers in Abbeville, Anderson, Greenwood and McCormick Counties. The Cooperative purchases electricity from Duke Energy. Little River Electric is a Touchstone Energy Partner and a member of the Electric Cooperatives of South Carolina and the National Rural Electric Cooperative Association**.**

10.3.2.2 Natural Gas

Greenwood CPW is the sole natural gas provider in Greenwood County. The Natural Gas Unit began operation in 1940, initially serving only customers within the City of Greenwood. In 1946, the natural gas system became a part of the combined public works system that is now called the Commissioners of Public Works (CPW). CPW now provides natural gas within a territory of 310 square miles that extends from the Town of Chappells to the City of Belton. In addition to the City of Greenwood, CPW is the natural gas supplier to the Towns of Donalds, Hodges, Ware Shoals and Ninety Six. The CPW natural gas system has approximately 44 miles of high pressure transmission mains and 717 miles of distribution lines.

The CPW system has interconnections with two interstate pipelines – the Transcontinental Gas Pipe Line and the South Carolina Pipeline Company (SCPC). Greenwood CPW purchases nearly all of its natural gas from Trans-Continental Pipeline, a subsidiary of Williams Energy, and a small amount from South Carolina Pipeline, a subsidiary of SCANA. Transcontinental is one of the largest natural gas producers in the nation, providing interstate natural gas transportation, primarily via pipeline, from the Gulf Coast to markets in eastern and southeastern states. SCPC pioneered the expansion of safe and cost-effective gas service into much of South Carolina beginning in the 1950s and has expanded its facilities to include nearly 2,000 miles of pipelines serving 40 of South Carolina's 46 counties.

10.3.2.3 Gasoline

While there are no gasoline production facilities or refineries in South Carolina, two major petroleum pipelines traverse the State, both through the Upstate region. Atlanta-based Colonial Pipeline Company and Plantation Pipeline Company are the owners and operators of the pipelines. Colonial Pipeline distributes an average of 100 million gallons of gasoline, diesel fuel, home heating oil, aviation fuel and military fuels through its 5,519 mile system. More than 600,000 barrels of petroleum products are distributed through the 3,100 mile Plantation Pipeline system daily. Products distributed by both companies originate from terminals in Texas, Louisiana, Mississippi and Alabama. Gasoline for Greenwood County is transported to terminals in Belton, North Augusta and Spartanburg, where it is distributed via truck to local public and private distributors.

10.3.2.4 Other Fuels

Greenwood Petroleum was the major distributor of commercial and home fuel oil in Greenwood County in 2001 and also provided more than three quarters (78.5%) of the kerosene sold in the County. The Company served customers in Greenwood, Abbeville, Laurens and Saluda Counties from 1914 until 2007, when H.D. Payne took over the fuel oil operation. Greenwood Petroleum purchased its fuel oil and kerosene from the British Petroleum Company (BP).

Stockman Oil provided 22.5% of the kerosene for Greenwood County consumers in 2001. Founded in 1932, the Company is a petroleum distributor, offering fuel, gasoline and lubricant products. Stockman Oil purchases its petroleum supplies from multiple suppliers including Citgo, Exxon, Mobil, and Shell. The company has warehouse locations in Greenwood and in Elberton and Lithonia, Georgia.

10.3.3 Energy Source Use Per Sector

Additional information on energy consumption can be gathered through closer examination of the types of energy used within each economic sector. Such analysis does not include transportation fuel consumption, which includes all types of transportation regardless of the economic sector served. The industrial sector was by far the largest consumer of energy in Greenwood County in 2001 at 62.3%. The residential sector accounted for 23.4% and the commercial sector for 14.3% of energy consumption within the County.

In 2001, residential customers paid an average of $14.82 per MMBtu for energy, while commercial customers paid $13.60 per MMBtu. The average energy cost is $5 less per MMBtu for industrial customers at only $8.56 per MMBtu. Even with a lower energy rate, industrial consumers collectively pay more than half of the total energy expenditures in the County for all sectors at $51.8 million.

Figure 10-8. Total Energy Distribution by Sector in Greenwood County, 2001

Sector	Energy Distributed per Sector		Energy Cost	
	MMBtu	% MMBtu	Total	Per MMBtu
Residential	2,270,229.8	*23.4%*	$33,655,493	$14.82
Commercial	1,391,714.7	*14.3%*	$18,924,294	$13.60
Industrial	6,056,190.9	*62.3%*	$51,834,379	$8.56
Total	**9,718,135.4**	***100.0%***	**$104,414,166**	**$10.74**

More than 5.6 million MMBtu of electricity per year is distributed to all economic sectors. The industrial sector is also the largest user of electricity, purchasing 63.1% of the total energy generated by electricity for Greenwood County consumers. Nearly one-fourth (24.1%) of electricity is distributed to residential customers and 12.8% to the commercial sector.

While the industrial sector accounts for more than half (52%) of the total cost of electricity in the County, industrial users pay the least per MMBtu at $10.78. Residential and commercial customers pay substantially more per MMBtu for electricity at nearly $17.

Figure 10-9. Electricity Distribution by Sector in Greenwood County, 2001

Sector	Amount Distributed per Sector			Cost	
	kWh	MMBtu	% MMBtu	Total	per MMBtu
Residential	397,799,411	1,357,689.6	*24.1%*	$23,010,288	$16.95
Commercial	210,499,713	718,435.7	*12.8%*	$12,014,625	$16.72
Industrial	1,040,152,724	3,550,041.1	*63.1%*	$38,257,022	$10.78
Total	**1,648,451,848**	**5,626,166.4**	***100.0%***	**$73,281,935**	**$13.03**

More than four million MMBtu of energy produced by natural gas were distributed in Greenwood County in 2001. Nearly 62% of the natural gas energy distributed in the County is for the industrial sector. Residential use accounts for 21.9% of natural gas distribution and 16.3% is distributed to the commercial sector.

The total cost of natural gas was highest in the industrial sector. However, industrial users paid the least per MMBtu for energy at $5.41. Residential customers paid more than twice that rate at $11.74 per MMBtu, while commercial customers paid slightly less than double the industrial rate at $10.31 per MMBtu.

Figure 10-10. Natural Gas Distribution by Sector in Greenwood County, 2001

Sector	Amount Distributed per Sector			Cost	
	Mcf	MMBtu	% MMBtu	Total	per MMBtu
Residential	859,738	885,530.1	*21.9%*	$10,393,296	$11.74
Commercial	639,599	658,787.0	*16.3%*	$6,794,009	$10.31
Industrial	2,425,076	2,497,828.3	*61.8%*	$13,514,357	$ 5.41
Total	**3,924,413**	**4,042,145.4**	***100.0%***	**$30,701,662**	**$ 7.60**

Energy produced by fuel oil for all economic sectors in Greenwood County totaled 38,125.9 MMBtu per in 2001. Nearly 42% of fuel oil was distributed to residential consumers, 36.6% to commercial customers, and 21.8% to industrial consumers. Prices for fuel oil averaged $8.15 per MMBtu for all sectors, with residential customers paying slightly more at $8.65 per MMBtu. Prices were lower for commercial and industrial customers at $7.93 and $7.57, respectively.

Figure 10-11. Fuel Oil Distribution by Sector in Greenwood County, 2001

Sector	Amount Distributed per Sector			Cost	
	Gallons	MMBtu	% MMBtu	Total	per MMBtu
Residential	114,300	15,852.3	*41.6%*	$137,160	$8.65
Commercial	100,600	13,952.2	*36.6%*	$110,660	$7.93
Industrial	60,000	8,321.4	*21.8%*	$63,000	$7.57
Total	**274,900**	**38,125.9**	***100.0%***	**$310,820**	**$8.15**

Only 11,698 MMBtu of energy produced by kerosene was distributed in Greenwood County to consumers in the residential and commercial sectors in 2001. Nearly all of the kerosene distributed in the County (95.4%) was used by the residential sector, with only 4.6% distributed to the commercial sector. No kerosene was used by the County's industrial sector. Kerosene consumers paid an average of $10.24 per MMBtu. Residential kerosene users paid $10.28 per MMBtu and commercial consumers paid slightly less at $9.26 per MMBtu.

It is important to note that kerosene consumption in South Carolina has gradually declined in recent decades, experiencing a 50.8% drop from 1980 to 2000.

Figure 10-12. Kerosene Distribution by Sector in Greenwood County, 2001

Sector	Amount Distributed per Sector			Cost	
	Gallons	MMBtu	% MMBtu	Total	per MMBtu
Residential	82,651	11,157.9	*95.4%*	$114,750	$10.28
Commercial	4,000	540.0	*4.6%*	$5,000	$ 9.26
Industrial	0	0.0	*0.0%*	$0	$ 0.00
Total	**86,651**	**11,697.9**	***100.0%***	**$119,750**	**$10.24**

10.3.4 Renewable and Nonrenewable Energy and Local Resources

Renewable energy sources are natural, but flow-limited, resources that can be replenished. Renewable energy resources include biomass, hydro, geothermal, solar and wind. Such resources are virtually inexhaustible in duration, but limited in the amount of energy that is available per unit of time. Some resources (such as geothermal and biomass) may be stock-limited in that stocks are depleted by use, but on a time scale of decades, or perhaps centuries, they can likely be replenished.

Nonrenewable resources are sources of energy that cannot be replenished naturally or that can take millions of years to produce. Nonrenewable energy resources include fossil fuels such as coal, oil, natural gas, and nuclear fuel (uranium).

While total energy consumption in the US declined by 2% from 2007 to 2008, renewable energy consumption grew by 10%, comprising more than 7% of the Nation's total energy consumption. Renewable energy consumption for the production of electricity also increased by 8% and was bolstered by a 60% increase in wind energy consumption and modest gains in conventional hydroelectric power. The electric power sector, which includes electric utilities and independent power producers, accounted

for 94% of renewable energy used for electricity generation in 2008. Biomass energy in the industrial sector accounted for most of the balance in consumption. The EIA's *2010 Annual Energy Outlook* projects this trend to continue. While fossil fuels will continue to provide most of the energy consumed in the US in the coming 25 years, their share of overall energy use will fall from 84% in 2008 to 78% by 2035.

Hydroelectricity is considered a renewable resource. The small percentage of electricity provided to Greenwood CPW by the Southeastern Power Administration is produced by federal hydroelectric generation facilities. A small percentage of the electricity provided by Duke Energy also comes from hydroelectric generation facilities. The remaining energy distributed within Greenwood County is generated from nonrenewable sources such as nuclear power, coal, oil, and natural gas.

While much of the energy distributed in Greenwood County is generated within South Carolina, very little local energy is generated within the County. Most of the County's electricity is generated at the Duke Energy Oconee Nuclear Station. However, some electricity is generated by Duke Energy's Buzzard's Roost facility in Greenwood County. Natural gas and petroleum products are refined and distributed from southeastern facilities outside of South Carolina.

10.3.5 Environmental Impact of Local Energy Resources

Emissions from petroleum-based products such as carbon monoxide, nitrogen oxides, carbon dioxide (CO_2), hydrocarbons, particulates and other toxins are the major components of smog and pollution. EPA statistics show that motor vehicles, including nonroad vehicles, account for about half of toxic air pollutant emissions and 75% of carbon monoxide emissions nationwide.

Air pollution levels are cause for concern for several reasons. Air pollution causes health problems in humans, wildlife and plantlife. The National Oceanic and Atmospheric Administration (NOAA) estimates that $150 billion is spent annually in the US on health problems related to air pollution. Air pollution also damages water supplies, introducing new toxins into water bodies. In addition, scientists have linked air pollution and high levels of carbon dioxide in the atmosphere to the "greenhouse effect" and global warming. When carbon dioxide and other gases in the air absorb infrared radiation in the atmosphere, the atmosphere cannot release energy at the same rate it takes energy in, resulting in a slight rise in temperature. Such seemingly small temperature changes can eventually cause drastic changes in the atmosphere.

The consumption of energy in the form of fossil fuel combustion is the largest single contributor to greenhouse gas emissions both nationwide and worldwide. The EIA reports that during 2008, more than 82% of total US greenhouse gas emissions consisted of carbon dioxide from the combustion of fossil fuels such as coal, petroleum, and natural gas. Emissions of greenhouse gases in 2008 were 3% less than in 2007, but were 16.3% higher than in 1990. The decline can be attributed to the decrease in carbon dioxide emissions in 2008; higher energy prices, especially during the summer driving season; slowing economic growth; and a decrease in the carbon intensity of the energy supply.

Greenwood County energy consumers rely primarily on automotive fuels, electricity and natural gas for their energy supplies. The generation and use of each of these fuel sources can have a significant impact on the environmental quality of Greenwood County and the surrounding region.

10.3.5.1 Transportation

EIA data reveals that South Carolina's transportation sector contributes 36.8% of the State's air pollution. Estimates developed by the EPA indicate that an average personal vehicle in the United States emits 10,000 pounds of carbon dioxide (CO_2) per year.

There were 41,950 registered automobiles, 15,050 trucks, 16,344 untaxed vehicles (including state and local government, higher education, public utilities and school vehicles), 22 common carriers (public transport) and 728 motorcycles in Greenwood County in 2002. Greenwood County motorists traveled more than 874 million miles in 2002, consuming more than 44.7 million gallons of fuel.

Figure 10-13. Greenwood County Registered Vehicles - Fuel Consumption and Mileage, 2002

Vehicle Type	Number of Vehicles	Total Fuel Consumed (gallons)*	Total Miles Traveled	CO_2 per mile (lbs)**	Total CO_2 Produced (lbs)
Passenger Car	41,950	**22,904,700**	502,896,600	0.911	458,138,803
Truck	15,050	**10,053,400**	175,844,200	1.131	198,879,790
Common Carriers	22	**15,818**	262,042	0.999	261,780
Motorcycles	728	**34,944**	1,755,208	0.391	686,286
Untaxed	16,344	**11,751,336**	194,085,000	0.999	193,890,915
Total	**74,094**	**44,760,198**	**874,843,050**		**851,857,574**

**Based on Federal Highway Administration Estimates, 2000*
*** Rocky Mountain Institute Estimates, 1999*

Based on national estimates developed by the Rocky Mountain Institute, Greenwood County motorists produced more than 851.8 million pounds, or 425,929 tons, of carbon dioxide in 2002. Using State averages, it can be assumed that transportation emissions account for a significant portion of the County's total yearly carbon dioxide emissions. Through travel reduction strategies detailed in Section 10.6 – such as carpooling, public transit, alternative travel modes and development of connected roadways – significant reductions in CO_2 emissions can be realized. The Institute estimates that each gallon of fuel saved diverts 20 pounds of carbon dioxide from the atmosphere.

10.3.5.2 Electricity

The United States relies heavily on fossil fuels and nuclear power to generate its electricity. Electricity generation is responsible for 40.6% of carbon dioxide emissions in the United States *(EIA, 2008)*. With its high carbon content and 48% share of electrical generation, coal accounts for 82.4% of national CO_2 emissions from the electric utility industry.

In South Carolina, emissions from all coal-fired generating units at the State's electric utilities increased by 75% from 1990 to 2008 *(EIA, 2008)*. In 2008, carbon dioxide from coal-fired plants accounted for 92.7% of emissions from electricity generating units in the State. As the pollution control most often used at electric utility plants, particulate collection is primarily designed to remove the ash generated from coal combustion.

Electricity comprises 58% of the energy distributed within Greenwood County. The majority of electricity (84%) for Greenwood County consumers is produced and distributed by Duke Energy, while 16% is purchased from Duke Energy and the Southeastern Power Administration and distributed to residents within the City of Greenwood by Greenwood CPW.

Nuclear energy generates approximately half of the electricity produced by Duke Energy. The Oconee Nuclear Station supplies much of the electricity for the Greenwood County area. Although nuclear power generation does not produce greenhouse gases, it does have by-product wastes in the form of radioactive materials and hot water. Most nuclear waste is low-level, in the form of tools, protective clothing, cleaning materials and disposable items that have been contaminated with small amounts of radioactive dust or particles. These materials are subject to special regulations that govern their storage so that they will not come in contact with the outside environment.

The remainder of the electricity generated by Duke Energy is from coal, oil or gas combustion, and hydro electricity. Duke Energy's Buzzard's Roost plant in Greenwood County generates electricity using combustion turbine (gas) units. More than 82% of total greenhouse gas emissions nationwide consist of carbon dioxide from the combustion of fossil fuels such as coal, petroleum and natural gas. It is assumed that electricity generation through fossil fuels is one of the key contributors to greenhouse gas emissions in South Carolina. It is important to note that for each unit of energy produced, natural gas emits about one-half and petroleum fuels about three-quarters of the carbon dioxide produced by coal.

The small percentage of energy purchased by Greenwood CPW from the Southeastern Power Administration, along with a possible small percentage of the electricity purchased from Duke Energy, is generated by hydroelectric power. Hydroelectric power is a renewable, clean and inexpensive source of

energy. Because hydroelectric generation does not involve fuel combustion, there is little air pollution in comparison with fossil fuel plants and limited thermal pollution compared with nuclear plants. Like other energy sources, the use of water for generation has limitations, including environmental impacts caused by damming rivers and streams, which can affect local plant, fish, and animal habitats.

10.3.5.3 Natural Gas

Natural gas is the cleanest of the fossil fuels. On a Btu basis, natural gas combustion generates about half as much carbon dioxide as coal, as well as less particulate matter and very little sulfur dioxide. The combustion of natural gas does produce nitrous oxides and the production and transmission of natural gas also results in the release of methane. However, natural gas is not considered a major contributor to the concentration of these gases within the atmosphere.

Natural gas use is slowing but still on the rise, both within South Carolina and nationwide. EIA data shows that end user deliveries of natural gas in the State increased by 5% from 1999 to 2008. Most of the increase occurred in the electric power sector, where natural gas deliveries increased by 341.5%. Natural gas sales to SC customers increased by 8.4% to commercial customers and 5.6% to residential customers, but dropped by nearly 30% to industrial customers from 1999 to 2008. At the national level, natural gas consumption is projected to increase from 23.91 quadrillion cubic feet in 2008 to 25.56 quadrillion cubic feet in 2035. Much of the increase in the nation's natural gas use is expected in the electricity sector, where electricity generators are projected to account for 29.8% of total US natural gas consumption by 2035. The EIA predicts the potential for increased use of natural gas in the electric power section over the next few years will be limited by a combination of relatively slow growth in total demand for electricity, strong growth in generation from renewable sources, and the completion of a number of coal-fired power plants already under construction. However, several factors could impact this scenario such as the enactment of policies that make the use of coal for electricity generation less attractive or slowing growth in renewable electricity. Policies could also be enacted that would make the use of natural gas in sectors such as transportation more attractive.

Natural gas is a major energy source in Greenwood County, providing nearly 42% of the County's energy in 2001. The commercial sector is a key consumer, with more than 47% of its energy coming from natural gas. Natural gas is widely used in the industrial and residential sectors as well, comprising 41% of industrial energy and 39% of residential energy. Given national and state trends, it is reasonable to assume that use of natural gas within all economic sectors will continue to grow in Greenwood County, replacing energy sources that are more detrimental to the environment.

10.3.5.4 Environmental Impact Summary

All energy sources for Greenwood County are imported. With the exception of transportation emissions, a relatively small amount of greenhouse gases are produced by sources within the County. In addition, much of the electricity for County consumers is generated by nuclear power, a very clean energy source in terms of greenhouse gas emissions. Natural gas, the cleanest of the fossil fuels, powers key electric generators that supply the County's energy resources. A small percentage of the County's electricity is produced by hydroelectric power, a renewable resource with minimal environmental impact. However, energy produced by transportation fuels within the County generates 425,929 tons of carbon dioxide a year. In general, with the exception of emissions related to transportation, Greenwood County is a good citizen within its region in terms of environmental impact on air quality.

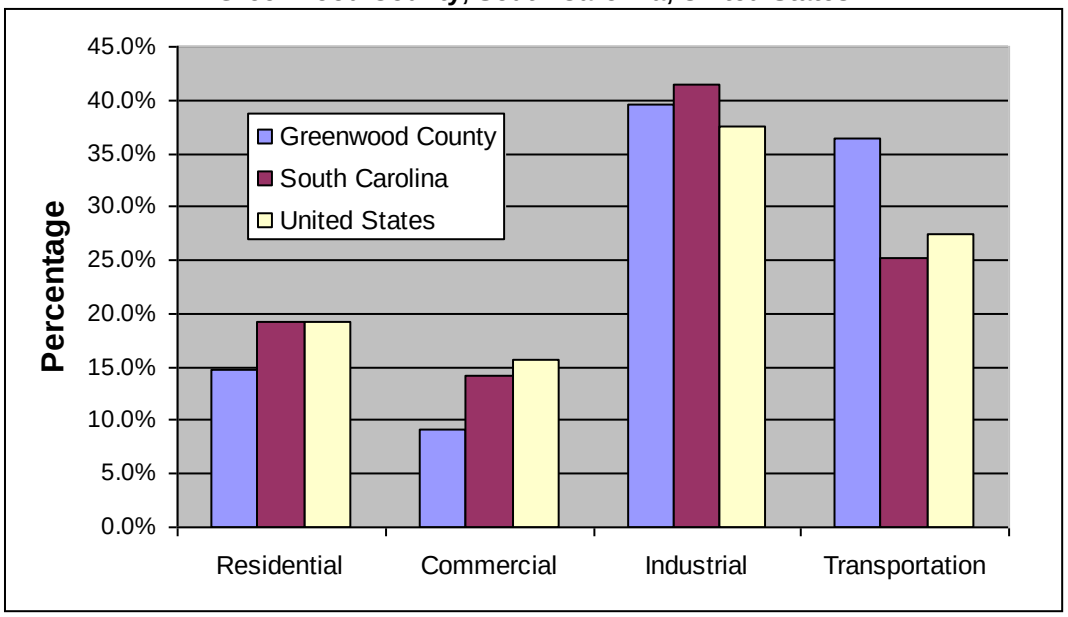
10.4 Inventory of Current Usage

A comprehensive community energy assessment builds upon the information provided through an identification and analysis of energy sources and related costs coupled with an examination of major end-use sector energy consumption. This analysis includes an examination of the energy characteristics and needs that influence energy consumption within each economic sector. The South Carolina Energy Office (SCEO) divides major energy consumers into four primary categories: residential, commercial, industrial, and transportation. In addition to activities included in the SCEO sector definitions, the Greenwood County Energy Conservation Element also includes institutional uses such as K-12 schools, higher education, hospitals, and local government uses and agricultural uses within the commercial sector.

Energy consumption within Greenwood County's economic sectors closely reflects that of the State and the nation. More than 15.3 million MMBtu of energy is distributed in Greenwood County annually. The industrial sector is the largest consumer of energy at the County, State and national level. In Greenwood County, industrial energy consumption accounts for 39.5% of energy distributed per year (more than 6 million MMBtu) – slightly lower than the State at 41.0% and higher than the national average of 34.1%. The share of transportation energy within the total energy picture is significantly higher in Greenwood County at 36.5% (nearly 5.6 MMBtu per year) than at the State level (24.2%) and nationally (27.3%). Greenwood County's residential sector accounts for a lower percentage of total energy use at 14.8% (nearly 2.3 million MMBtu) than statewide at 20% and nationally at 20.8%. The commercial sector in Greenwood County also uses proportionally less energy at 9.1% (nearly 1.4 million MMBtu) than at the State (14.8%) and national (17.8%) levels.

Greenwood County's comparatively high use of energy in the transportation sector and lower use of energy in the residential and commercial sectors is in large part due to the rural nature of the County. With nearly 44% of its population classified as rural in the 2000 Census, Greenwood County is more rural than the State (39.5% rural) and the nation (21% rural). Because rural areas are generally characterized by longer travel times, more sparse residential development, and in most cases less commercial development, more energy is needed for transportation, while less energy is used in the residential and commercial sectors. No public transit options and limited private transit in Greenwood County make it critical for residents to have access to a personal vehicle, resulting in an increased number of vehicles per person. In general, Greenwood County residents are financially positioned to afford personal vehicles. County residents ranked 17th highest in per capita income and 20th highest in median household income among the State's 46 counties in the 2000 Census, and ranked significantly higher than surrounding counties in these income measures. In addition, the City of Greenwood is the center for business, health care, industry and government services in the six-county Upper Savannah region. The vehicle fleets associated with these activities increase the number of vehicles per person in the County when compared with surrounding rural counties and the State as a whole.

Figure 10-14. Percentage of Energy Consumption by Economic Sector, 2001
Greenwood County, South Carolina, United States



Source: EIA State Energy Data System, 2010.

Figure 10-15. Energy Distribution by Sector in Greenwood County, 2001

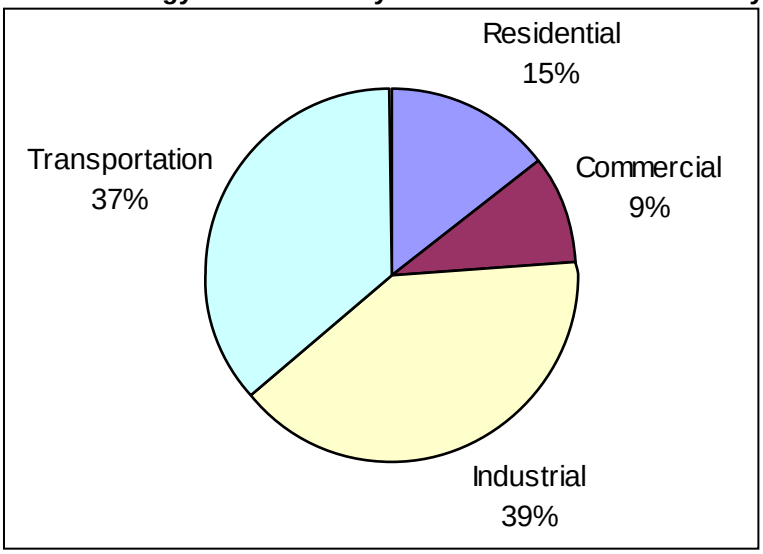


Figure 10-16. Energy Distribution and Cost by Sector in Greenwood County, 2001

Sector	Energy Distributed per Sector		Energy Cost		
	MMBtu	% MMBtu	Total	% of Total	per MMBtu
Residential	2,270,229.8	*14.8%*	$33,665,493	*21.3%*	$14.83
Commercial	1,391,714.7	*9.1%*	$18,924,294	*12.0%*	$13.60
Industrial	6,056,190.9	*39.5%*	$51,834,379	*32.9%*	$ 8.56
Transportation	5,595,024.8	*36.5%*	$53,264,636	*33.8%*	$ 9.52
Total	**15,313,446.9**	***100.0%***	**$157,685,163**	***100.0%***	**$10.30**

Greenwood County consumers spend more than $157.6 million a year for energy. With a few exceptions, the share of the total energy cost paid by each economic sector within the County mirrors the percentage of energy distributed within each sector. Although the industrial sector is the largest consumer of energy in the County, the transportation sector pays the largest percentage of energy costs at 33.8% ($53.2 million). Greenwood County's percentage of energy costs attributed to transportation is lower than that of the State (37.9%) and the nation (37.6%). The County's industrial sector expends more than $51.8 million a year for energy, nearly one-third (32.9%) of the total energy costs. This is significantly higher than the industrial sector's share of energy costs at the State (24%) and national (20.2%) levels. Although the residential sector accounts for only 14.8% of energy use in Greenwood County, it pays 21.3% of total energy costs with a total annual expenditure of more than $33.6 million. The residential sector share of total energy expenditures runs higher statewide at 23.6% and nationally at 24.1%. Similarly, the commercial sector pays for 12% of total annual energy costs ($18.9 million) in the County, although it consumes only 9.1% of the total energy distributed. In comparison, the commercial sector accounts for 14.5% of energy expenditures in South Carolina and 18.1% of expenditures nationwide.

Figure 10-17. Percentage of Total Energy Distributed and Total Cost by Sector, 2001
Greenwood County, South Carolina and the United States

Sector	Greenwood County		South Carolina		United States	
	% of Energy	% of Cost	% of Energy	% of Cost	% of Energy	% of Cost
Residential	14.8%	21.3%	20.0%	23.6%	20.8%	24.1%
Commercial	9.1%	12.0%	14.8%	14.5%	17.8%	18.1%
Industrial	39.5%	32.9%	41.0%	24.0%	34.1%	20.2%
Transportation	36.5%	33.8%	24.2%	37.9%	27.3%	37.6%

Source: EIA State Energy Data System, 2010.

10.4.1 Residential Energy Use

The residential sector includes all private household establishments that consume energy primarily for space heating, water heating, air conditioning, lighting, refrigeration, cooking and clothes drying. To understand energy use within the residential sector, it is important to examine the demographic factors that have some bearing on energy consumption. In addition to specific energy data, population and housing characteristics can provide additional insight into energy distribution and trends.

American Community Survey (ACS) data estimates Greenwood County's population at 68,549 in 2008, an increase of 3.4% from 2000. There were 30,023 housing units in the County, with 80.4% (24,143) occupied. More than 76% of the occupied housing units in the County are owner-occupied, with 23.8% renter occupied. Single-family detached homes constitute 68.4% of the County's housing stock, with manufactured housing representing 13.2%. More than 14% of the County's housing units are part of multi-family developments with three or more attached units. Nearly 2% of the County's housing units are duplexes and 2.3% are attached single-family units such as townhomes.

Figure 10-18. Housing Type and Units in Structure, Greenwood County, 2008

Units in Structure	Number	Percent
Total HU	**30,023**	***100.0%***
1-unit, detached	20,537	*68.4%*
1-unit, attached	702	*2.3%*
2 units	553	*1.8%*
Multi-family 3+ units	4,254	*14.2%*
Mobile Home	3,977	*13.2%*

Source: US Census Bureau, 2008 American Community Survey

More than half (58.8%) of the housing stock in Greenwood County was built before 1970. Nearly 42% of units were built before 1960, with 10% constructed before 1939. Conversely, more than 7% of the County's housing stock was built in 2000 or later and is fairly new construction.

Figure 10-19. Year Housing Unit Built, Greenwood County, 2008

Year Structure Built	Number	Percent
Total Housing Units	**30,023**	***100.0%***
2005 or later	1,113	*3.7%*
2000 - 2004	1,014	*3.4%*
1990 - 1999	5,326	*17.7%*
1980 - 1989	4,928	*16.4%*
1970 - 1979	5,156	*17.2%*
1960 - 1969	3,575	*11.9%*
1940 - 1959	5,921	*19.7%*
1939 or earlier	2,990	*10.0%*

Source: US Census Bureau, 2008 American Community Survey.

The type of energy used to heat Greenwood County homes was almost evenly divided between electricity at 52.4% of homes and natural gas at 42% of homes (ACS, 2008). More than 12,600 homes in the County are heated by electricity and 10,132 are heated by natural gas. This differs from statewide usage in which 65.3% of South Carolina homes are heated by electricity and only 25.5% by natural gas. Other heating fuels are used to a lesser extent in the County, with 531 homes heated by fuel oil or kerosene, 470 homes heated by bottled or tank LP (propane) gas, and 293 homes heated by the burning of wood.

Figure 10-20. House Heating Fuel – Occupied Housing Units, 2008
Greenwood County and South Carolina

House Heating Fuel	Greenwood County		South Carolina	
	Number	Percent	Number	Percent
Natural Gas	10,132	*42.0%*	433,651	*25.5%*
Bottled, Tank or LP Gas	470	*1.9%*	92,474	*5.4%*
Electricity	12,656	*52.4%*	1,111,818	*65.3%*
Fuel Oil, Kerosene, etc.	531	*2.2%*	37,577	*2.2%*
Coal or Coke	0	*0.0%*	144	*0.0%*
Wood	293	*1.2%*	19,831	*1.2%*
Solar Energy	0	*0.0%*	220	*0.0%*
Other Fuel	0	*0.0%*	1,223	*0.1%*
No Fuel Used	61	*0.3%*	5,362	*0.3%*
Total Housing Units	**24,143**	***100.0%***	**1,702,300**	***100.0%***

Source: US Census Bureau, 2008 American Community Survey.

Data obtained from Greenwood County energy providers provides a slightly different picture of the types of energy used in residences. Nearly 2.3 million MMBtu was distributed to residential uses in Greenwood County in 2001. Almost 60% of this residential energy, totaling more than 1.3 million MMBtu, was provided by electricity. This is slightly less than the 62.4% of residential energy provided by electricity at the State level. Thirty-nine percent of Greenwood County's residential energy (885,530 MMBtu) comes from natural gas – significantly higher than at the State level, where only 20.4% of residential energy is provided by natural gas. Less than 1% of the County's total residential energy is provided by either fuel oil or kerosene.

Greenwood County consumers spent more than $33.6 million annually for residential energy in 2001, at a cost of $14.82 per MMBtu. Although electricity provided 59.8% of residential energy, it comprised 68.4% ($23 million) of the total residential energy cost in the County. While natural gas customers consumed 39% of the energy in the residential sector, they paid only 30.9% ($10.3 million) of the total cost of residential energy. Fuel oil and kerosene customers paid less than 1% of the total cost of energy in the residential sector. Electricity customers in Greenwood County paid the most for energy at 16.95 per MMBtu. Natural gas consumers paid $11.74 per MMBtu, with kerosene cost following closely at $11.74 per MMBtu. Customers who heat their homes with fuel oil paid the least for energy at $8.65 per MMBtu.

Figure 10-21. Residential Energy by Energy Type in Greenwood County, 2001

Type	Amount Distributed		Cost		
	MMBtu	% of MMBtu	Total	% of Total	per MMBtu
Electricity	1,357,689.5	*59.8%*	$23,010,288	*68.4%*	$16.95
Natural Gas	885,530.1	*39.0%*	$10,393,296	*30.9%*	$11.74
Fuel Oil	15,852.3	*0.7%*	$137,160	*0.4%*	$8.65
Kerosene	11,157.9	*0.7%*	$114,750	*0.4%*	$10.28
Total	**2,270,229.8**	***100.0%***	**$33,655,493**	***100.0%***	**$14.82**

10.4.2 Commercial Energy Use

The commercial sector includes wholesale and retail trade; finance and insurance; real estate; professional; management; administration; arts, entertainment, and recreation; accommodations and food service; repair and maintenance; and personal services. The Greenwood County Energy Element includes institutional uses such as K-12 schools, higher education, government, hospitals and agricultural within the commercial sector.

The US Census Bureau's *2008 County Business Patterns* indicates there were 1,480 commercial establishments in Greenwood County. More than 19% (286) of these commercial establishments were engaged in retail trade, 11.1% (165 establishments) in the provisions of other services, 9.9% (146 establishments) in health care and social assistance, and 8.6% (128 establishments) in accommodations and food service. Figure 10-22 provides additional information on commercial establishments in Greenwood County.

Figure 10-22. Commercial Establishments in Greenwood County by Type, 2008

Type of Business	Establishments	Percentage
Retail Trade	286	*19.3%*
Other Services	165	*11.1%*
Health Care and Social Assistance	146	*9.9%*
Accommodations/Food Service	128	*8.6%*
Finance & Insurance	125	*8.4%*
Professional, Scientific & Technical Services	120	*8.1%*
Manufacturing	76	*5.1%*
Administration, Support, Waste Mgmt., Remediation	73	*4.9%*
Real Estate	63	*4.3%*
Wholesale Trade	57	*3.9%*
Transportation & Warehousing	24	*1.6%*
Arts/Entertainment/Recreation	18	*1.2%*
Information	17	*1.1%*
Management	11	*0.7%*
Total Establishments*	**1,480**	

* Total includes establishments not represented in the table

Source: US Census Bureau, 2008 County Business Patterns.

Greenwood County's commercial sector consumed 1.39 million MMBtu in 2001 *(Figure 10-23)*. More than half (51.6%) of this energy, totaling 718,435 MMBtu, was provided by electricity. Comparatively, SCEO data shows electricity use in the commercial sector was significantly higher statewide at 63.9% (*South Carolina Energy Use Profile*, *2001*). Natural gas accounted for 47.3% (658,787 MMBtu) of the energy used by County commercial consumers. Commercial sector usage was substantially less at the State level, with only 22.7% of energy provided by natural gas. Fuel oil and kerosene provided only 1% each of the total energy consumed by the County's commercial sector.

Commercial energy consumers in Greenwood County spent more than $18.9 million on energy in 2001, at a cost of $13.60 per MMBtu. While electricity provided 51.6% of the energy within the commercial sector, it made up 63.5% of the total energy cost for the sector. Conversely, natural gas accounted for 47.3% of energy distributed within the commercial sector, yet represented only 35.9% of the total energy cost for commercial consumers. Both commercial fuel oil and kerosene customers paid less than 1% of the total cost of energy within the sector. Electric consumers in the commercial sector paid significantly more than other sectors for their energy at $16.72 per MMBtu. Commercial natural gas consumers paid $10.31 per MMBtu, followed closely by kerosene customers who paid $9.26 per MMBtu. Commercial consumers using fuel oil as their energy source paid the least for energy at only $7.93 per MMBtu.

Figure 10-23. Commercial Electricity by Energy Type in Greenwood County, 2001

	Amount Distributed		Cost		
Type	MMbtu	% of MMbtu	Total	% of Total	per MMbtu
Electricity	718,435.5	*51.6%*	$12,014,625	*63.5%*	$16.72
Natural Gas	658,787.0	*47.3%*	$6,794,009	*35.9%*	$10.31
Fuel Oil	13,952.2	*1.0%*	$110,660	*0.6%*	$7.93
Kerosene	540	*1.0%*	5000	*0.6%*	$9.26
Total	**1,391,714.7**	***100.0%***	**$18,924,294**	***100.0%***	**$13.60**

10.4.2.1 Energy Use in Institutional Facilities

Although included within the broader commercial sector, institutional uses can have a significant impact on community energy conservation initiatives. Institutional uses including government facilities, K-12 schools and higher education offer promising opportunities for energy conservation within the realm of comprehensive planning. As high profile energy consumers, hospitals, local governments, K-12 schools, and postsecondary institutions have an opportunity to promote energy conservation through the efficient use of energy within their operations. These entities are among the leading consumers of energy within a community. This is due in part to the size of public buildings and facilities, coupled with the fact that such

facilities are often older and less energy efficient. Operational requirements of institutions also significantly impact energy use. Police, fire and hospital facilities are in operation 24 hours a day, using energy around the clock. Hospitals, schools, higher education and other public buildings have higher traffic in and out of the buildings, significantly increasing the heating and cooling needs of such facilities.

The Self Regional Healthcare system includes the Self Regional Medical Center in Greenwood, the Montgomery Center for Family Medicine in Greenwood, the Savannah Lakes Medical Center in McCormick County, and the Ware Shoals Center for Family Medicine. The system's 33 buildings house patient care facilities including a women's center, heart center, neonatal intensive care, emergency care center, critical and intensive care, orthopedic, neurological and eye, ear/nose/throat, vascular unit, telemetry, outpatient surgery, operating room, spine center, pain management center, wound healing center, and pediatrics. The Self Regional Medical Center serves a population of more than a quarter of a million that includes residents of Greenwood, Abbeville, Edgefield, Laurens, McCormick, Newberry, and Saluda counties. The 411-bed Center is one of Greenwood County's largest employers with 2,327 employees (1,966 full-time) including a medical staff of more than 180 physicians representing more than 42 specialty areas.

As shown in Figure 10-24, Self Regional Medical Center is one of the County's major energy consumers, accounting for more than 13% of total energy use, or 184,770 MMBtu, within Greenwood County's commercial sector in 2002. More than 57% of this energy was provided by natural gas and 43% by electricity, both supplied by Greenwood CPW.

Figure 10-24. Self Regional Medical Center Energy Use, 2002

Electric (KWh)	Electric (MMBtu)	% *Electric*	Natural Gas (Decatherms)	Natural Gas (MMBtu)	% *Natural Gas*	Total MMBtu
23,105,784	78,860	*42.7%*	105,910	105,910	*57.3%*	**184,770**

Source: Self Regional Medical Center, 2003.

Self Regional Medical Center spent more than $1.5 million for energy in 2002. This expenditure represents nearly 8% of total energy expenditures in the County's commercial sector for 2002. The Hospital's average cost per MMBtu was $8.18, significantly lower than the average Greenwood commercial sector cost of $13.60 per MMBtu.

Figure 10-25. Annual Estimated Energy Distribution and Cost, 2002
Self Regional Medical Center

Number of Buildings	MMBtu	Cost	Average Cost per MMBtu
27	184,770	$1,511,740	**$8.18**

Source: Self Regional Medical Center, 2003.

Government entities in Greenwood County spend $691,150 annually for energy, with an average price of $14.53 per MMBtu. Figure 10-26 provides energy distribution and cost for Greenwood County jurisdictions. Greenwood County, the City of Greenwood, and the Towns of Ninety Six and Ware Shoals consume more than 47,580 MMBtu per year of energy in the operation of their facilities.

With a total of 53 buildings, Greenwood County is the largest governmental energy consumer, using nearly 32,829 MMBtu per year at a total cost of $467,000. The average price of energy used in County facilities is $14.23 per MMBtu. The largest consumers of energy among County facilities are the Law Enforcement Center (8,333 MMBtu/year), the County Courthouse (4,861 MMBtu/year) and the five Parks and Recreation buildings (4,723 MMBtu/year). Greenwood CPW provides natural gas and electricity for the County's buildings located within the Greenwood City limits, with Duke Energy supplying electricity for the landfill and several ancillary buildings located outside of the corporate limits.

The City of Greenwood consumes 7,560 MMBtu a year in the operation of its five municipal buildings, including the City Hall, the Public Works building and two fire stations. The City spends $112,042 on energy each year, with an average cost per MMBtu of $14.82. Greenwood CPW provides electricity and natural gas for the operation of all five of the City's buildings.

The Town of Ninety Six consumes 3,020 MMBtu a year in the operation of its nine municipal buildings and provision of citywide street lighting. Ninety Six spends approximately $47,608 a year for energy, with street lighting being the largest energy expense at a cost of $24,754 annually. Street lights account for nearly half of the energy consumed by the municipality, using more than 1,491 MMBtu per year. The average cost of energy for the Town is $15.76 per MMBtu – higher than that of neighboring jurisdictions due to the Town's dependence on electricity, particular for street lighting. Duke Energy provides electricity for all of the Town's facilities and street lighting. Greenwood CPW provides natural gas for the Police and Fire Station, the Library, the Depot and Town Hall.

The Town of Ware Shoals consumes nearly 4,171 MMBtu annually in the operation of its nine municipal buildings and the provision of street lighting citywide. Like Ninety Six, street lighting is both the major energy use and expense for Ware Shoals, representing nearly half (2,018 MMBtu) of the Town's energy usage and accounting for more than half ($33,500) of the total energy cost. The average cost of energy for Ware Shoals is $15.46 per MMBtu. Similar to Ninety Six, the average cost of energy is a little higher than neighboring jurisdictions because of the large percentage of electricity used for street lighting. Duke Energy provides electricity and Greenwood CPW provides natural gas for all nine Town facilities. Duke Energy provides electricity for the Town's street lighting.

Figure 10-26. Annual Government Energy Distribution and Cost by Jurisdiction, YEAR
Greenwood County Jurisdictions

Jurisdiction	Estimated Energy Distributed			
	MMBtu	Number of Buildings	Cost	Average Cost per MMBtu
Greenwood County	32,828.9	53	$467,000	$14.23
City of Greenwood	7,560.2	5	$112,042	$14.82
Town of Ninety Six	3,020.5	9	$47,608	$15.76
Town of Ware Shoals	4,170.8	7	$64,500	$15.46
Total	**47,580.4**	**74**	**$691,150**	**$14.53**

Greenwood County is served by three school districts through a total of 22 public schools. More than 1.7 million square feet are included in 65 buildings that house 11,670 students. Greenwood School District 50 is the largest within the County in terms of land area, number of schools and students served. District 50 has an administrative building and 16 schools including nine elementary schools, three middle schools, two high schools, an alternative school, and the District's Career Center – which is shared with Districts 51 and 52. District 50 accommodates a 2009 enrollment of 8,973 students within more than 1.2 million square feet of building space.

Greenwood School District 51 serves 1,077 students from the Ware Shoals community and much of the northern area of Greenwood County, along with portions of Laurens and Abbeville Counties. District 51 has three schools including a primary school (4K through 3rd grade), an elementary school (4th through 6th grades) and one high school for students in grades 7 through 12. The District has three schools (7 buildings) that include 278,338 square feet of building space.

Greenwood School District 52 (Ninety Six School District) serves 1,620 students residing in the Ninety-Six community and the eastern portion of Greenwood County. Three schools comprised of 22 buildings that total 262,297 square feet of space. The District operates one elementary school (4K through 5th grade), a middle school (grades 6 through 8) and one high school for students in grades 9 through 12.

Greenwood County's school districts consumed 105,326.5 MMBtu in 2008. More than 73% of the district energy was provided by electricity and 26.8% by natural gas. District 50 was the largest energy consumer, using more than three quarters (75.4%) of the total energy distributed to the County's school districts. Nearly three-fourths of the total energy consumption in District 50 and District 51 was derived from electricity. Energy sources for Districts 52 were a little more diverse, with 32.5% provided by natural gas.

Figure 10-27. Energy Use in Greenwood County Public K-12 Schools by Type, 2008

School District	Electric (KBtu)	% Electric	Natural Gas (KBtu)	% Natural Gas	Total KBtu	Total MMBtu
Greenwood 50	58,961,991.40	*74.2%*	20,500,500.00	*25.8%*	79,462,491.40	**79,462.49**
Greenwood 51	7,684,157.89	*74.3%*	2,657,500.00	*25.7%*	10,341,657.89	**10,341.66**
Greenwood 52	10,483,572.17	*67.5%*	5,038,800.00	*32.5%*	15,522,372.17	**15,522.37**
County Total	**77,129,721.47**	***73.2%***	**28,196,800.00**	***26.8%***	**105,326,521.47**	**105,326.52**

Source: SC Energy Office Preliminary Public Facilities Data, 2008.

The school districts of Greenwood County spent more than $2 million on energy in 2008 at an average cost of $19.29 per MMBtu. Greenwood District 50 paid more than three fourths of that total cost – spending over $1.5 million for energy in 2008. District 51 spent $218,685 for energy in 2008, while District 52 spent a total of $287,260 for electricity and natural gas. Energy prices were lower for District 52 at $18.57 per MMBtu, while Districts 51 and 52 paid $19.18 and $21.15 per MMBtu, respectively.

Figure 10-28. Energy Use and Cost in Greenwood County Public K-12 Schools, 2008

School District	Square Footage	Total MMBtu	Total Cost	Cost per MMBtu
Greenwood 50	1,207,210	79,462.49	$1,524,350	$19.18
Greenwood 51	278,338	10,341.66	$218,685	$21.15
Greenwood 52	262,297	15,465.65	$287,260	$18.57
County Total	**1,747,845**	**105,269.80**	**$2,030,295**	**$19.29**

Source: Preliminary Public Facilities Data, SC Energy Office, 2008.

Greenwood County is host to two quality institutions of higher education. Lander University (a 4-year public institution) and Piedmont Technical College (a 2-year public institution) provide a wide range of advanced educational opportunities to residents of Greenwood County and the surrounding region. Lander University is a four-year, state-assisted university situated on approximately 100 acres within the City of Greenwood. The campus includes 41 buildings, with a total of 978,018 square feet of building space. The University operates 8 residence halls that accommodate up to 1,216 students. The University's 130,000-square-foot John Drummond Complex includes the 2,500 seat Finis Horne Arena and houses the Division of Physical Education and Exercise Studies.

Lander University consumed 67,534.5 MMBtu in 2008. The majority of this energy (78.8%) was provided by electricity, with natural gas accounting for 21.2% of the energy distribution to the University *(Figure 10-29)*. The number of campus buildings and square footage of these facilities is a major factor in energy use. As a residential institution, Lander also provides housing to more than 1,200 students – resulting in around-the-clock energy consumption.

Piedmont Technical College is a comprehensive 2-year post-secondary institution serving approximately 4,500 students from Abbeville, Edgefield, Greenwood, Laurens, McCormick, Newberry and Saluda Counties. Since Piedmont Tech serves the largest land area of all technical colleges in South Carolina, the College maintains a mini-campus in each county to mitigate geographic barriers to educational attainment. The Lex D. Walters main campus is located in the City of Greenwood. In addition to the main campus, the College operates six full-service, high-tech facilities, equipped with both traditional and distance learning classrooms, computer labs, and library resource centers. Piedmont Tech currently operates a total of 28 buildings on its main and satellite campuses, with a total of 448,165 square feet of building space.

More than 29,000 MMBtu of energy was distributed to Piedmont Technical College in 2008. Electricity comprised 74% and 26% was provided by natural gas. As a two-year, nonresidential institution, energy consumption for Piedmont Tech is lower than that of a four-year residential institution.

Figure 10-29. Energy Use in Institutions of Higher Education by Type, 2008
Greenwood County

Institution	Electric (Kbtu)	% Electric	Natural Gas (Kbtu)	% Natural Gas	Total Kbtu	Total MMBtu
Lander University	53,228,475.6	78.8%	14,306,000.0	21.2%	67,534,475.6	**67,534.5**
Piedmont Technical College	21,576,095.2	74.0%	7,591,200.0	26.0%	29,167,295.2	**29,167.3**

Source: SC Energy Office Preliminary Public Facilities Data, 2008.

Lander University paid more than $1.2 million for energy in 2008, at a cost of $17.79 per MMBtu and $1.23 per square foot. The total cost of energy for Piedmont Technical College in 2008 was $520,426, with a cost of $17.84 per MMBtu and $1.16 per square foot.

Figure 10-30. Energy Use and Cost in Institutions of Higher Education, 2008
Greenwood County

Institution	Square Footage	Total MMBtu	Total Cost	Cost per MMBtu	Cost per Sq Ft
Lander University	978,018	67,534.5	$1,201,209	$17.79	$1.23
Piedmont Technical College	448,165	29,167.3	$520,426	$17.84	$1.16

Source: SC Energy Office Preliminary Public Facilities Data, 2008.

10.4.3 Industrial Energy Use

The EIA includes manufacturing, construction, mining, agriculture, fishing, and forestry establishments within the industrial sector. In Greenwood County, agriculture energy use has been included in the commercial sector. To understand industrial energy use in the County, it is important to examine the types and sizes of industries. There were 76 manufacturing establishments in Greenwood County in 2008, with 28.2% (7,528) of County workers employed in the manufacturing sector (*2008 County Business Patterns*, Census). The Greenwood County Economic Alliance lists 14 manufacturers with 200 or more employees *(Figure 10-31)*.

Figure 10-31. Industries with 200 or more Employees in Greenwood County, 2007

Manufacturer	Employees	Products
Fuji Photo Film, Inc	1,505	Photographic products – film, paper, cameras
Solutia, Inc.	950	Nylon fiber manufacturing
Greenwood Packing Plant	740	Beef and pork products, corporate headquarters
Capsugel-Division of Pfizer Inc	680	Gelatin capsules
Eaton/Cutler-Hammer	490	Med voltage power distribution gear
Covidien	470	Medical/surgical products
VELUX Greenwood Inc	450	Roof windows/fixed windows
George W Park Seed Co Inc	400	Packaged seed and gardening supplies
Grede Foundry-Greenwood Plant	380	High volume engineered gray iron casting
Greenwood Mills - Matthews Plant 3	280	Dacron/rayon suiting; dacron cotton poplin
Greenwood Mills - Harris Plant	260	Cloth computer ribbon; polyester, twills, poplin, oxfords
Eaton Hydraulics Corp	250	Hydraulic piston pumps
Goodrich Corp	206	Proprietary coatings
Cooper Power Systems	200	Electric power transformers

Source: Partnership Alliance, Greenwood SC, website: http://greenwoodpartnershipalliance.com, 2010.

The *2008 County Business Patterns* also indicated that 11 agriculture, forestry, fishing, and hunting support businesses operate within Greenwood County, along with two mining establishments and 143 construction businesses. Census information estimates that more than 100 Greenwood County workers were employed in agriculture, forestry, fishing and hunting, and mining in 2008. Nearly 5% of the Greenwood County workforce (1,248 workers) were employed in construction in 2008.

The industrial sector was the largest energy consumer in Greenwood County in 2001, consuming more than 6 million MMBtu *(Figure 10-32)*. Nearly 59% of this industrial energy, totaling more than 3.5 million MMBtu, was provided by electricity while more than 41% was in the form of natural gas. This is much higher than at the State level, where electricity provided only 27.2% of energy consumed in the industrial sector. Use of natural gas was much lower statewide, where it provided only 26.2% of industrial energy. Fuel oil contributed minimally to industrial sector energy usage and there was no use of kerosene.

Greenwood County industrial customers spent more than $51.8 million for energy in 2001. The industrial sector paid the lowest energy rates off all economic sectors, averaging $8.56 per MMBtu. Although electricity comprised 58.6% of the industrial energy used countywide, it comprised 73.8% ($38.2 million) of the total energy cost for the sector. Conversely, while natural gas consumers used 41.2% of industrial sector energy, they accounted for only 26.1% ($13.5 million) of the total energy cost in the sector. Fuel oil constituted a very minimal portion of total industrial energy costs. Industrial sector electric consumers paid the highest rate at $10.78 per MMBtu, while rates for industrial natural gas customers were nearly half the rate at $5.41 per MMBtu. Fuel oil cost $7.57 per MMBtu for the few industrial customers.

Figure 10-32. Industrial Electricity by Energy Type in Greenwood County, 2001

	Amount Distributed		Cost		
Type	MMbtu	% of MMbtu	Total	% of Total	per MMbtu
Electricity	3,550,041.2	*58.6%*	$38,257,022	*73.8%*	$10.78
Natural Gas	2,497,828.3	*41.2%*	$13,514,357	*26.1%*	$ 5.41
Fuel Oil	8,321.4	*0.1%*	$63,000	*0.1%*	$ 7.57
Kerosene	0	*0.0%*	0	*0.0%*	$ 0.00
Total	**6,056,190.9**	***100.0%***	**$51,834,379**	***100.0%***	**$ 8.56**

10.4.4 Transportation Energy Use

The transportation sector consists of all vehicles with a primary purpose to transport people and/or goods from one physical location to another. Included are automobiles, trucks, buses and motorcycles. Vehicles whose primary purpose is not transportation such as tractors and construction equipment are excluded.

The transportation sector is a major energy consumer in Greenwood County, accounting for 37% of total energy use in 2001. This is in large part due to the nation's dependence on the automobile. US Census and the Federal Highway Administration data indicate that the growth in travel has outpaced population growth since the 1960s. The total number of vehicle trips taken by all Americans increased more than twice as fast as the population in the 1990s. This dependence is mirrored in Greenwood County, where 94.4% of residents travel to work by car, truck or van – 2.4% more than the State average and 8.2% higher than the national average *(Figure 10-33)*.

Figure 10-33. Journey to Work, 2008
Greenwood County, South Carolina and the United States

Workers 16 and Older	Greenwood County	South Carolina	United States
Means of Transport to Work			
Car, Truck or Van	94.4%	92.0%	86.2%
Drove Alone	86.1%	81.1%	75.5%
Travel Time to Work			
15 - 29 minutes	35.5%	40.5%	36.1%
30 to 59 minutes	9.9%	25.6%	27.3%
60 or more minutes	4.7%	5.1%	8.2%
Mean Travel Time to Work (minutes)	20.3	23.2	25.5

Source: US Census Bureau, 2008 American Community Survey.

More than 86% of Greenwood workers travel to work alone, significantly higher than the 81.1% of workers in South Carolina and 75.5% of workers nationally who drive alone. On the other hand, Greenwood residents enjoy comparatively shorter commutes to work. Mean travel time to work for Greenwood residents was 20.3 minutes in 2008, shorter than the State mean of 23.2 minutes and the national mean travel time of 25.5 minutes. Nearly 15% of County residents drive 30 minutes or more to work one way,

with only 4.7% traveling an hour or more. In comparison, 30.7% of residents statewide and 35.5% of workers nationwide travel more than 30 minutes to work.

Automobiles and light trucks consume a large portion of the total energy used within the transportation sector because they are very energy intensive. Cars and trucks consume more energy per mile than all other modes of ground transportation. Energy savings can be realized per person when the mode of travel is capable of transporting larger numbers of people (buses), or even when an automobile or light truck transports more than one person per trip. As a result, local bus systems and vanpools use less than one-third the energy of automobiles and less than one-fifth of the energy of light trucks.

Figure 10-34. Transportation Intensity by Mode

Transportation Mode	Average Energy Intensity (Btu per mile traveled)
Bicycle	140
Pedestrian	400
Van Pool	600
Bus - Intercity	1,000
Motorcycle	2,300
Bus - Transit	3,400
Automobile	3,600
Light Truck	5,000

Source: Peter Miller and John Moffet, "The Price of Mobility: Uncovering the Hidden Costs of Transportation," 1993.

There were 74,094 licensed vehicles in the County (*Greenwood County Auditor, 2002*). Of these vehicles, 41,950 were passenger cars, 15,050 were trucks, 728 were motorcycles, 22 were common carriers (vehicles that provide commercial transport such as taxis), and 16,344 were designated as "untaxed." The high number of vehicles carrying the "untaxed" designation included the fleets of state and local governments, police and fire, school buses, higher education, public utilities, and other organizations that are exempt from vehicle taxes. Individual Greenwood County residents with disabilities who meet specific eligibility requirements are not taxed as well.

Fuel consumption for each vehicle type can be estimated using vehicular fuel consumption data developed by the Federal Highway Administration. Vehicles registered in Greenwood County consumed nearly 5.6 million MMBtu of energy in 2002. Passenger cars were the largest energy consumers among various vehicle types, accounting for more than half of the energy used within the transportation sector (2.86 million MMBtu). Untaxed vehicles (including government fleet cars and school buses) consumed 26.3% (1.4 million MMBtu) of energy used within the County's transportation sector and trucks accounted for 22.5% (1.2 million MMBtu) of transportation energy use.

Figure 10-35. Vehicular Energy Consumption in Greenwood County, 2002

Vehicle Type	Number of Vehicles	Average Fuel Consumption (gallons)*	Total Fuel Consumed (gallons)	Total MMBtu	% MMBtu
Passenger Car	41,950	546	**22,904,700**	2,863,087.5	*51.2%*
Truck	15,050	668	**10,053,400**	1,256,675.0	*22.5%*
Common Carriers	22	719	**15,818**	1,977.3	*0.0%*
Motorcycles	728	48	**34,944**	4,368.0	*0.1%*
Untaxed	16,344	719	**11,751,336**	1,468,917.0	*26.3%*
Total	**74,094**		**44,760,198**	**5,595,024.8**	

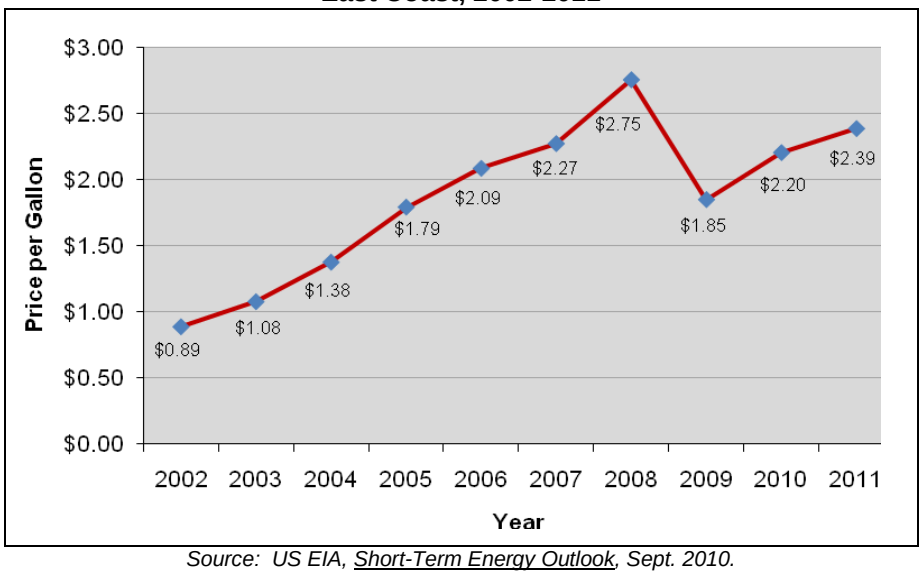
Sources: Greenwood County Auditor, 2002; Federal Highway Administration, 2000.

Fluctuations in petroleum prices since 2002 create a challenge for estimating the cost of transportation fuel. Average fuel consumption by vehicle type can be estimated using information provided by the Federal Highway Administration. The average fuel price per gallon began a steady rise in late 2002 that continued into the first months of 2003. South Carolina gasoline prices in February 2003 averaged more than 50 cents per gallon higher than the preceding year. Since it was not expected that fuel prices would

go down within the following years in an appreciable way, use of 2002 fuel price averages was much too low to use in a credible estimate of the total cost of transportation fuel. Instead, to ensure a more realistic estimate of the average price per gallon for gasoline in the nearby Columbia region in February 2003 ($1.49 per gallon) was used to estimate total transportation costs for Greenwood County.

Gasoline price trend data indicates that the average price per gallon for transportation fuels began a steady rise in late 2002 that continued into 2008, then dropped substantially in 2009 (EIA, 2010). The average price for regular grade gasoline (not including taxes) in South Carolina fell by $0.95 in 2009. The EIA projects that gas prices in the East Coast states will resume their uphill climb in the short-term through 2011 *(Figure 10-36)*.

Figure 10-36. Average Annual and Projected Regular Grade Gasoline Prices East Coast, 2002-2011



Source: US EIA, Short-Term Energy Outlook, Sept. 2010.

The estimated total annual energy cost for Greenwood County's transportation sector was more than $66.6 million in early 2003. Fuel for passenger cars accounted for more than half (51.1%) of the total energy cost for the sector, with an annual cost of more than $34 million. Energy costs were $17.5 million for untaxed vehicles and more than $14.9 million for trucks, accounting for 26.4% and 22.5% of total transportation sector energy costs, respectively

Figure 10-37. Estimated Vehicular Energy Cost in Greenwood County, 2003

Vehicle Type	Number of Vehicles	Average Fuel Consumption (gallons)*	Total Fuel Consumed (gallons)	Average Price per Gallon, Columbia Region 10/10*	Annual Transportation Fuel Bill
Passenger Car	41,950	546	**22,904,700**	$1.49	$34,128,003
Truck	15,050	668	**10,053,400**	$1.49	$14,979,566
Common Carriers	22	719	**15,818**	$1.49	$23,569
Motorcycles	728	48	**34,944**	$1.49	$52,067
Untaxed	16,344	719	**11,751,336**	$1.49	$17,509,491
Total	**74,094**		**44,760,198**	**$1.49**	**$66,692,695**

Sources: Greenwood County Auditor, 2002; Federal Highway Administration, 2000; SouthCarolinaGasPrices.com.

Of all the economic sectors, the transportation sector offers the greatest opportunity to significantly reduce energy consumption within the Greenwood region. State, regional and local governments have wide-ranging legal and financial powers to influence transportation. They directly supply or regulate the supply of most transportation infrastructure including roadways, sidewalks, transit, bike paths, and parking. If improvements and additions to transportation systems are designed with energy conservation in mind, significant energy savings can be realized.

10.4.4.1 Energy Use in Transportation Fleets

As part of the transportation sector, transportation fleets are an important component of local energy use and merit closer examination. Both the City of Greenwood and Greenwood County operate sizable fleets that include a variety of vehicles. There were a total of 231 vehicles in the County fleet in 2009. More than 42% of the County-owned vehicles were passenger cars, 37.2% were light trucks including sport utility vehicles, and 15.2% were heavy trucks. The City's transportation fleet totaled 111 vehicles in 2009 and was comprised of 36% passenger cars, 34.2% heavy trucks, and 29.7% light trucks.

Figure 10-38. Fleet Inventory, 2009
Greenwood County and City of Greenwood

Vehicle Type	Greenwood County	City of Greenwood
Passenger Car	98	40
Light Truck	86	33
Heavy Truck	35	38
Ambulance	12	0
Total	**231**	**111**

Source: City of Greenwood and Greenwood County, 2010.

Greenwood County spent more than $604,220 to fuel its on-road vehicles in 2009, using 132,481.5 gallons of gasoline and 135,319.5 gallons of diesel fuel. The County obtains a contracted purchase price for fuel, resulting in significant savings. Contracted prices for the County in 2009 were significantly lower than average fuel prices at $2.26 for gasoline and $2.25 for diesel fuel. County vehicles consumed 58,863.5 MMBtu of energy in 2009, with diesel fuel producing 71.9% of that energy.

The City of Greenwood expended an estimated $197,121.49 for transportation fleet fuel in 2009. The City's vehicles consumed 58,045.5 gallons of gasoline and 46,547 gallons of diesel fuel during that year, at a price ranging from $1.31 to $2.13 per gallon for gasoline and $2.09 for diesel fuel. The City's fleet consumed 13,711.3 MMBtu of energy in 2009, with 52.9% of that energy provided by gasoline and 47.1% by diesel fuel.

Figure 10-39. Fleet Energy Use and Expenditure, 2009
Greenwood County and the City of Greenwood

City of Greenwood				
Fuel Type	**$/Gallon**	**Gallons**	**Price**	**MMBtu**
Gasoline	$1.31 - $2.13	58,045.5	$99,838.26	7,255.7
Diesel Fuel	$2.09	46,547.0	$97,283.23	6,455.6
Total		**104,592.5**	**$197,121.49**	**13,711.3**
Greenwood County				
Gasoline	$2.26	132,481.50	$299,199.44	16,560.2
Diesel Fuel	$2.25	135,319.50	$305,020.99	42,303.4
Total		**267,801.00**	**$604,220.43**	**58,863.5**

Source: City of Greenwood and Greenwood County, 2010.

The SC Department of Education operates and maintains the school bus fleets for Greenwood County School Districts 50, 51 and 52. A total of 88 buses provide transportation for students in the County, with all powered by diesel fuel. More than $326,924 was spent on fuel for the County school bus fleet in 2009. The buses consumed 184,703 gallons of diesel fuel, at an average price of $1.77 per gallon. School buses serving County students consumed 25,616.5 MMBtu in 2009.

Figure 10-40. Greenwood County School Bus Fleet Energy Use and Expenditure, 2009

Greenwood County School Districts - Buses				
Fuel Type	**$/Gallon**	**Gallons**	**Price**	**MMBtu**
Diesel Fuel	$1.77	184,703.0	$326,924.31	25,616.5

Source: SC Department of Education, 2010.

Fleet management practices represent one of the greatest opportunities for local governments to reduce energy consumption within their operations. Many of these practices are relatively simple and inexpensive to implement. When it is time to replace older vehicles, the purchase of fuel efficient models will substantially reduce fuel consumption over time. Carefully matching tasks with the appropriate vehicle can ensure that the most fuel-efficient vehicles are used whenever possible. Regular maintenance, including proper tire inflation, will keep vehicles operating efficiently, while integration of optimal operational procedures will reduce unnecessary stops and other gas intensive driving habits.

10.5 Projected Future Energy Needs

When conducting a comprehensive community energy assessment it is important to develop an understanding of the community's future energy needs. An analysis of future energy needs provides the critical data needed to build an effective plan for energy conservation that will be viable for decades to come.

Population projections are the most reliable and readily available projections of future growth, with energy need projections generally based on per capita energy use. The Division of Research and Statistics of the State Budget and Control Board provides population projections by county based on the most recent Census data. Local projections have also been developed by the Greenwood City/County Planning Department. Greenwood County's population is projected to grow by 8.6% from 2010 to 2020. This growth rate is lower than the projected statewide growth rate of 10.4% from 2010 to 2020.

Figure 10-41. Population Projections, 2010 and 2020
Greenwood County and South Carolina

	2000	% Growth 2000-2010	2010	% Growth 2010-2020	2020
Greenwood County	66,271	*8.0%*	71,604	*8.6%*	77,737
South Carolina	4,012,012	*13.4%*	4,549,150	*10.4%*	5,020,400

Source: SC State Budget & Control Board, Division of Research and Statistics, 2010; Greenwood City/County Comprehensive Plan, Population Element.

In its *2010 Annual Energy Outlook*, the EIA predicts that demand for energy, including fuels for electricity generation, will grow by 0.5% per year through 2035. The fastest growth will be in the commercial sector, which will be propelled by growth in population and commercial floor space, but will be constrained somewhat by tightening efficiency standards. Energy use for transportation is projected to grow by 0.6% per year during the same time period. Energy consumption in the industrial sector will grow more modestly as US output continues to shift towards less energy-intensive industries.

The EIA projects a slight increase in per capita energy demand as the economy rebounds, followed by a yearly decline of 0.3% per year starting in 2013 as higher efficiency standards for vehicles and lighting begin to take effect. Per capita residential energy use is expected to decline to 16% below the 2008 level by 2035, attributable in part to a decrease in energy use for space heating due to a projected shift in populations from colder to warmer regions of the Country. However, this reduced demand for home heating fuels will be offset in part by increased demand for air conditioning. Recent improvements in household energy efficiency and the introduction of new energy-efficient electric appliances have been offset by growth in residential square footage.

10.5.1 Electricity and Natural Gas

Per capita energy use in the non-transportation sector of Greenwood County's energy consumers was 146.6 MMBtu in 2000. Electricity and natural gas are the primary sources of energy in this sector locally and at the State and national levels, providing 99.5% of all energy used in the residential, commercial and industrial sectors. Per capita electricity use for Greenwood consumers was 84.9 MMBtu and per capita natural gas consumption was 61 MMBtu in 2000.

Figure 10-42. Energy Consumption Per Capita (MMBtu) in Greenwood County, 2000

2000 Population	Total Energy use	Per Capita Energy Use	Electricity Use	Per Capita Electricity Use	Natural Gas Use	Per Capita Natural Gas Use
66,271	9,718,135.4	146.6	5,626,166.2	84.9	4,042,145.4	61.0

In developing energy projections on a per capita basis, it stands to reason that if the population of the community is increasing, increasing amounts of electricity and natural gas will be needed to support the growing population. However, this methodology does not address a few, less quantifiable factors:

- New uses that could significantly alter per capita electricity consumption such as electric vehicles;
- New businesses and industries that may use large quantities of energy but do not represent an increase in population;
- Energy efficiency improvements in buildings, equipment and appliances; and
- Effective energy conservation programs.

Total energy use in Greenwood County is projected to grow by 8% from 2000 to 2010 – rising by more than 782,000 MMBtu *(Figure 10-43)*. From 2000 to 2020, energy consumption is expected to rise by 1.68 million MMBtu – a growth of 17.3%. The County's total energy consumption by 2010 is projected to be more than 10.5 million MMBtu, rising to nearly 11.4 million by 2020.

Consumption of energy generated by electricity in Greenwood County is expected to grow by 452,752 MMBtu in the first decade of the century and by 973,422 MMBtu by 2020. Natural gas consumption is projected to increase by 325,282 MMBtu in 2010 and by 699,359 MMBtu by 2020.

Figure 10-43. Projected Energy Consumption Per Capita (MMBtu), 2000 - 2020
Greenwood County

Year	Population	Per Capita Energy Use	Total Energy Use	Per Capita Electricity Use	Total Electricity Use	Per Capita Natural Gas Use	Total Natural Gas Use
2000	66,271	146.6	9,718,135.4	84.9	5,626,166.2	61.0	4,042,145.4
2010	71,604	146.6	10,500,179.1	84.9	6,078,918.4	61.0	4,367,427.4
2020	77,737	146.6	11,399,536.6	84.9	6,599,587.8	61.0	4,741,504.7

To maintain or decrease the current level of energy use as the population of the County grows, per capita energy use would have to decrease by approximately 1.08 MMBtu (316.5 kWh) a year. Though this may seem like a small amount, it is significant in relation to the average energy use for a single-family home in the Greenwood area at 22,188 kWh per year. By comparison, the energy needed to provide lighting for the average home is 1,445 kWh (*Home Energy Saver website, US Environmental Protection Agency*). While it may be difficult to maintain or decrease per capita energy use, it is important to minimize rising energy consumption within all economic sectors. Although emerging technologies may offer some relief to rising energy use, the most significant energy savings can be realized through policies and programs that promote and integrate energy conservation into the daily lives of community residents.

Using total energy cost data and 2000 census population data, it is estimated that Greenwood consumers paid more than $1,575 per capita for energy in 2000. Per capita cost for electricity was $1,105.75, with the cost of natural gas at $463.27 per person.

Figure 10-44. Greenwood County Energy Cost per Capita, 2000

2000 Population	Total Energy Cost	Per Capita Energy Cost	Electricity Cost	Per Capita Electricity Cost	Natural Gas Cost	Per Capita Natural Gas Cost
66,271	$104,414,167	$1,575.56	$73,281,935	$1,105.79	$30,701,662	$463.27

Source: 2000 Population - US Census Bureau, 2000 Census.

As demand for energy increases, so does the total cost of energy. However, several additional factors are key in the projection of energy prices including unit price changes and availability of supplies. Trends such as energy supply disruptions and international conflicts can affect energy supplies and prices in the short-term. Long-term projections are based on fundamental issues including the availability of energy resources, emerging technologies, developments in the domestic electricity market and the impact of economic growth on projected energy demand. These factors are difficult to quantify at the local level and were not included in the Greenwood County projections.

The total cost of energy for Greenwood County is projected to grow by 8% from 2000 to 2010 – increasing by $8.4 million during that time period. From 2000 to 2020, the cost of energy is expected to increase by more than $18 million – a growth rate of 17.3%. The total energy cost for the County is projected to surpass $112.8 million by 2010, and exceed $122.4 million by 2020.

The cost of energy generated by electricity in Greenwood County is expected to increase by more than $5.8 million from 2000 to 2010 and by $12.6 million by 2020. Natural gas costs are projected to increase by more than $2.4 million by 2010 and by $5.3 million by 2020.

Figure 10-45. Projected Energy Cost per Capita in Greenwood County, 2000 - 2020

Year	Population	Per Capita Energy Cost	Total Energy Cost	Per Capita Electricity Cost	Total Electricity Cost	Per Capita Natural Gas Cost	Total Natural Gas Cost
2000	66,271	$1,575.56	$104,414,167	$1,105.79	$73,281,935	$463.27	$30,701,662
2010	71,604	$1,575.56	$112,816,647	$1,105.79	$79,179,123	$463.27	$33,172,305
2020	77,737	$1,575.56	$122,479,578	$1,105.79	$85,960,945	$463.27	$36,013,567

Average annual electricity prices are projected to fall nationwide from 9.8 cents per KWH in 2008 to 8.6 cents per KWH in 2011 due to a drop in fossil fuel prices and lower demand that coincides with the startup of new renewable, natural gas, and coal-fired capacity (*2010 Annual Energy Outlook, EIA*). After 2011, prices are projected to rise to 10.2 cents per KWH in 2035 in response to rising fuel prices and the construction of new power plants as demand rises. However, electricity prices are influenced by economic activity and could vary based on the level of recovery from the current recession. Electricity prices are based on generation, transmission and distribution costs. With natural gas-fired generation projected to increase in coming years, natural gas prices will greatly impact future electricity prices.

10.5.2 Transportation Fuels

With more than 74,000 registered motor vehicles in Greenwood County in 2002, the transportation sector represents a significant portion of total energy use, consuming 37% of total energy per year (more than 5.5 million MMBtu). Vehicles within the County consumed more than 44.7 million gallons of fuel in 2003. Passenger cars use more than half of the energy consumed within Greenwood County's transportation sector. Per capita energy use for the County's transportation sector was 84.4 MMBtu in 2000.

Figure 10-46. Transportation Energy Consumption per Capita (MMBtu), 2000
Greenwood County

2000 Population	Total Energy use	Per Capita Energy Use
66,271	5,595,024.8	84.4

Projections of per capita energy use in the transportation sector rely on several variables that can significantly affect fuel consumption. These factors are difficult to quantify at the local level and include:

- Increased vehicular fuel efficiency;
- Changes in the average number of vehicles per person;
- New technologies that rely on alternative energy sources such as electricity, ethanol, methanol, and natural gas; and
- Effective energy conservation programs.

Long-term projections indicate that energy for transportation will grow by 0.6% per year through 2035 – slower than the 1.3% average rate from 1980 to 2008 (*2010 Annual Energy Outlook, EIA*). The slower growth is attributed to changing demographics, improved fuel economy, and increased saturation of personal travel demand. Light duty vehicles (LDVs), including cars and light trucks, have accounted for 16% of total US energy consumption since 2002. Energy demand for LDVs is projected to increase by 10% by 2035, due to increased vehicle miles traveled as a product of anticipated slower growth in fuel prices and rising real disposable income. However, that share is expected to decline to 15.5% by 2020, when the average fuel economy of LDVs is required by the *Energy Independence and Security Act of 2007* to reach 35.5 miles per gallon. Market adoption of advanced technologies is expected to facilitate the improvements in fuel economy needed to meet these new, more stringent Corporate Average Fuel Economy (CAFE) standards. Unconventional vehicles (vehicles that use alternative fuels, electric motors, advanced electricity storage or other new technologies) are expected to account for nearly half of new LDV sales in 2035 and will play a significant role in meeting the new CAFE standards. Standard gasoline-electric or diesel-electric hybrid vehicles are expected to comprise 13% of new LDV sales by 2035. Other advanced technologies expected to facilitate improvements in fuel economy by 2035 include advanced drag reduction that reduces vehicle air resistance at higher speeds and camless valve activation, which can increase engine efficiency by up to 14%. Technologies that improve fuel economy such as turbocharging, supercharging, and cylinder deactivation are expected to increase from a 5% share of new LDV sales in 2008 to 57% by 2035.

Petroleum's share of liquid fuel use in the transportation sector is projected to decline as consumption of alternative fuels such as biodiesel, E85 and ethanol increases. Biofuels are expected to account for more than 80% of the growth in liquid fuel consumption in the coming years. Flexible fuel vehicles (FFVs) are projected to represent 41% of unconventional LDV sales in 2035 and 20% of all new LDV sales, in part due to increased availability.

More vehicles and vehicle trips are needed as the population of a jurisdiction increases, resulting in a growth in per capita consumption of transportation fuels. Energy use within Greenwood County's transportation sector is projected to increase by 450,246 MMBtu from 2000 to 2010. Energy consumption in the transportation sector is expected to rise by 968,033 MMBtu between the years 2000 to 2020. Total energy consumption for the County's transportation sector is projected to exceed 6 million MMBtu by 2010 and more than 6.5 million MMBtu by 2020.

Figure 10-47. Projected Transportation Energy Consumption Per Capita (MMBtu), 2000 - 2020
Greenwood County

Year	Population	Per Capita Energy Use	Total Energy Use
2000	66,271	84.4	5,595,024.8
2010	71,604	84.4	6,045,271.02
2020	77,737	84.4	6,563,058.39

Calculations using total transportation energy costs and Census 2000 population figures indicate that Greenwood County residents spent more than $63.6 million for transportation fuels in 2000. Per capita cost for transportation energy in the County was $959.77.

Figure 10-48. Transportation Energy Cost Per Capita in Greenwood County, 2000

2000 Population	Total Energy Cost	Per Capita Energy Cost
66,271	$63,604,808	$959.77

Similar to other energy fuels, as demand for energy increases, so does the total cost of transportation fuels. However, additional global factors may also affect transportation fuel prices. Transportation fuel prices fell by 27% in 2009, but increased steadily through the first half of 2010. This increase is expected to continue in the short-term, as higher crude oil prices combine with strengthening refiner margins. Transportation fuel supply and price is affected in the long-term by fundamental factors including dependence on imported supplies, increasing government support for the development and use of biofuels, and increased interest in alternative fuel vehicles such as electric, hybrid and natural gas vehicles. Given these variables, it is likely that fuel prices will continue to fluctuate well into the future.

The cost of transportation fuels in Greenwood County is projected to increase by $5,118 from 2000 to 2010. From 2000 to 2020, the cost of transportation energy is projected to increase by more than $11 million. The total cost of transportation energy is expected to be $68.7 million by 2010, rising to $74.6 million by 2020.

Figure 10-49. Projected Transportation Energy Cost Per Capita in Greenwood County, 2000-2020

Year	Population	Per Capita Energy Cost	Total Energy Cost
2000	66,271	$959.77	$63,604,808
2010	71,604	$959.77	$68,723,253
2020	77,737	$959.77	$74,609,512

Crude oil prices are determined largely by the international market and production in both Organization of Petroleum Exporting Countries (OPEC) and non-OPEC nations. Since gasoline is refined from crude oil, gasoline prices are closely related to crude oil prices. The EIA projects that despite the recent economic downturn and efforts by many countries to limit access to oil resources in their territories, a growing demand for energy – particularly in China, India, and other developing nations – will lead to rising oil prices over the long term. World oil prices are expected to rise slowly as global economic growth leads to higher global oil demand, growth in non-OPEC oil supply slows, and members of OPEC continue to support world oil prices.

Greenwood County, the City of Greenwood, and the Towns of Ninety Six and Ware Shoals can play a key role in the facilitation and implementation of local energy conservation efforts in the following areas:

- ***Leadership***. Local governments build and maintain infrastructure; purchase, manage and sell land; set standards, regulations, taxes and fees; procure large amounts of products and services; and provide key services such as water, waste management and transportation. By making energy conservation a visible priority in all of their policies and procedures, local governments are well-positioned to lead by example.

- ***Regulation***. Local governments can review and revise zoning and land development regulations, building codes and other requirements that hinder energy conservation and sustainable development.

- ***Coalition Building***. Local governments can convene development stakeholders to identify and discuss common ground on the issues of energy conservation and sustainable development. Because such solutions rarely follow jurisdictional boundaries, local governments can also seek partnerships with the public and private sectors to promote regional solutions and savings.

Working together, the members of the Energy Planning Advisory Committee (EPAC), Planning staff, the Planning Commission, and County and City Councils can foster support and encourage the adoption of energy conservation practices throughout the community. *Appendix C* lists sample programs and funding sources to assist in the implementation of local energy conservation measures.

10.6 Opportunities for Energy Conservation and Sustainability

Opportunities for promoting energy conservation and sustainability throughout Greenwood County, along with programs available to assist in implementation, are explored in the sections that follow. These opportunities are presented within a diverse planning context that includes natural resource conservation, economic development, housing, community facilities, transportation, and land use.

It is important to note that such opportunities cannot maximize energy savings if implemented in isolation. They must be included as a part of a comprehensive strategy that provides a breadth of energy conservation measures. Long-term success relies on the County working in cooperation with neighboring jurisdictions to establish regional approaches to energy conservation.

Many of these opportunities for energy conservation and sustainability will also help further the objectives of the seven basic elements of the Greenwood City/County Comprehensive Plan. Sound planning,

whether for energy conservation and sustainability or for the attainment of other community goals, speaks to a range of issues and will result in an improved quality of life for Greenwood residents.

10.6.1 Environmental Opportunities

While there are many ways to conserve energy, some of the most effective measures incorporate resources found in nature. Natural resources such as sunlight, wind, vegetation and water can address energy needs and reduce the demand for non-renewable energy sources. Landscaping, recycling, and the preservation of land for open space are just a few practical ways in which environmentally-based approaches can be used to save energy, conserve resources and improve environmental quality.

10.6.1.1 Urban Forestry and Landscaping

Land use and development density can have an adverse impact on both the local and global environments. The more densely an area is developed, the higher the temperatures are likely to be. On warm summer days with calm winds, city air can be 2 to 12 degrees Fahrenheit (ºF) hotter than the surrounding countryside. Dark roofs and paving materials absorb more of the sun's radiation than vegetation, causing both surface temperature and overall ambient temperature in urban areas to rise. This phenomenon, called the *urban heat island effect*, has intensified throughout the past century. The urban heat island effect significantly affects energy usage in cities. For every 1º Fahrenheit increase in summer temperatures, peak cooling loads increase by 1.5 to 2% *("Urban Trees, Air Quality, and Energy Conservation," American Planning Association*). The air conditioning needed to compensate for the urban heat island effect comprises 3% to 8% of urban electricity use, costing Americans an additional $1 billion annually.

Trees have been identified as a "low tech," cost-effective tool for energy conservation and can save energy by:

- Reducing the need for air conditioning through shade;
- Breaking the force of winter winds and lowering heat costs;
- Serving as a renewable source of fuel;
- Reducing air temperatures through evapotranspiration;
- Sequestering, or "locking up," carbon – an element that is a key factor in atmospheric pollution and the threat of global warming; and
- Reducing areas of lawn space that require the use of power mowers.

Urban forests have been shown to lower the ambient temperature of a city's summer "heat islands" if local tree canopies are sufficiently mature. Planting trees along streets reduces the heat absorbed by asphalt and can reduce the energy used for cooling in adjacent buildings. Evening ambient air temperatures in neighborhoods with well-shaded streets are up to 10ºF cooler than areas with less shading. The inclusion of trees in parking areas can also partially block the sun's rays onto parked cars, reducing temperatures both within the cars and in the fuel tanks. While cooler vehicle interiors require less initial air conditioning, cooler gas tanks result in less fuel evaporation and therefore less hydrocarbon emissions. The use of trees and other vegetation to reduce surface temperatures not only saves energy, it can also improve air quality and make urban environments more livable. According to the California Energy Commission, a healthy urban tree can also absorb 10 to 50 pounds of carbon dioxide (CO_2) per year, making the urban forest a valuable tool in controlling air pollution.

10.6.1.2 Open Space

Open spaces provide opportunities for preserving existing vegetation and introducing additional trees into an area. Open spaces are unimproved parcels or areas of land or water that are set aside, dedicated, designated, or reserved for resource protection and public or private use as active or passive recreation areas. While many jurisdictions require the inclusion of open space in new developments, some communities have developed comprehensive greenway systems that link open spaces and, in some cases, provide miles of uninterrupted greenways within urban or suburban areas. Greenways link a number of outdoor opportunities in a continuous corridor. A greenway can be a simple path surrounded by just enough natural vegetation to mask the sights and sounds of the city, or it can include linkages to larger open spaces such as a spacious park, wildlife refuge, or historic site.

Open spaces and greenways are popular primarily because of the visual beauty and recreational benefits they offer. The often unheralded, yet significant energy savings and improved air quality these spaces provide are less tangible benefits. As noted earlier, the trees and vegetation that are important features of open spaces and greenways help cool air temperatures in hot weather by providing shade and evapotranspiration. They also block cold winds in winter months, reducing energy needs for heating and cooling. When greenways are used for travel on foot or by bicycle to primary destinations such as work or school, they can also help reduce vehicle trips.

The Greenwood City and County Zoning Ordinances provide incentives for developers to include parks, open spaces, sidewalks and bicycle paths within new developments. Developers are allowed an increase in density of up to 35% when these amenities are included in the development. Pedestrian and bicycle paths are also encouraged as alternative modes of travel, thus reducing vehicle trips, while parks and open spaces are promoted to provide greater opportunities for preserving existing vegetation and introducing additional trees into the area.

10.6.1.3 Alternative Fuels

The use of nonrenewable energy sources dominates national and local energy consumption. However, continued reliance on and increasing levels of consumption of traditional sources such as coal, oil, and natural gas poses a future challenge as these natural resources are finite in supply and can be exhausted over time. Nuclear energy, a major energy source in South Carolina, is also a concern – generating toxic waste by-products and costly, long-term storage requirements.

Efforts to reduce our national dependence on these exhaustible resources and the potentially hazardous affects of nuclear energy are yielding viable fuel alternatives. These alternative fuels represent renewable energy sources that can be adapted to various communities based on regional and local geographic, climactic, and geological constraints.

The most widespread and promising of these alternative fuel sources for South Carolina communities such as Greenwood are solar, biofuel, and geothermal energy. Although the technology to capture and convert solar energy is now readily available, the cost-effectiveness of the technology at smaller scales remains the primary limiting factor for application at the local level. Biofuel potential is being realized through the Greenwood County landfill and the utilization of the landfill's methane gas as an energy source for County facilities, as well as for potential sale to local residences, businesses, or industry. Greenwood County will continue to explore opportunities to harness such naturally occurring energy and convert it into a usable product. Harnessing heat from beneath the Earth's surface, geothermal energy utilizes water and geothermal wells to warm and cool facilities. Geothermal heat pumps are among the most efficient and comfortable heating and cooling technologies available – and particularly suited for the State's moderate climate.

10.6.1.4 Recycling

Driven by environmental concerns, recycling can also yield significant energy savings. Less energy is used to produce products from recycled material than from virgin material. For example, producing aluminum cans from recycled materials uses 90% less energy than manufacturing cans from new materials, while savings for other metals range from about 50% to 90%. Producing recycled paper uses from 23% to 70% less energy, depending on the grade of paper.

The Greenwood County GAPPS Recycling Program is one of South Carolina's first curbside recycling programs, currently serving more than 18,000 households throughout the County. GAPPS (Glass, Aluminum, Paper, Plastic and Steel) represents the materials collected on the curbside routes. Recyclables are delivered to the Material Recovery Facility (MRF) located at the landfill complex for separation and processing by inmate laborers for sale to recycling vendors. The County also operates nine Solid Waste and Recycling Convenience Centers to serve residents who do not have curbside collection. Greenwood County's GAPPS program continues to grow, with the County's recycling rates increasing each year. Recycling has had a notable impact on the life of the County's Sub-title D landfill (the first approved site in South Carolina). The MRF processes around 2,500 tons of recyclable material a year. Without recycling, this material would have been disposed of at the rate of $35 per ton and would

have greatly decreased the life of the landfill. Recycling efforts to date have saved the equivalent of two cells of landfill space, extending the life expectancy of the County landfill by an estimated 16 to 20 years.

Figure 10-50. Energy Savings from the Recycling of Selected Waste Materials

Material	Million Btu per Ton Saved	Percent Energy Saved
Aluminum	168.5- 281.0	92 - 96%
Steel	7.8 - 19.0	47 - 74%
Steel and Iron	9.2 - 15.5	63 - 74%
Lead	5.5 - 17.4	56 - 65%
Copper	40.3 - 94.7	84 - 95%
Glass (20% recycled)	0.59	4%
Glass (50% recycled)	1.47	11%
Glass (100% recycled)	2.95	22%
Plastic – polyethylene	96.0	97%
Plastic – polymer	--	90 - 95%
Rubber	22.0 - 22.1	70 - 71%
Newspaper (33% recycled)	1.23	23%
Newspaper (100% recycled)	2.42	53%
Paper	14.0 - 35.5	60 - 70%
Low grade paper	12.0	70%
High grade paper	--	60%
Writing & printing paper	16.4	33%
Corrugated cardboard	6.3 - 12.2	24%
Paperboard	--	10 - 20%

Source: Energy Aware Planning Guide, California Energy Commission

10.6.1.5 Ambient Air Quality

Air quality affects public health, weather, quality of life, and the economic potential of a community. Air quality can be influenced by short-term, temporary events such as wildfires, or by more serious, long-term conditions such as ozone and haze. The federal *Clean Air Act* establishes federal standards for six primary air pollutants – ozone, lead, dust, carbon monoxide, nitrogen dioxide and sulfur dioxide.

One of the main concerns with air quality in South Carolina is ozone. Although ozone plays a key role in protecting the earth from solar radiation, problems can arise when it occurs in concentrated areas closer to ground level creating health risks for residents such as asthma, damaging vegetation, and escalating deterioration of outdoor structures. Ground-level ozone (O_3) forms when oxides of nitrogen and volatile organic compounds are heated by the sun during the spring and summer months. Ground-level ozone is a naturally occurring effect that humans can exacerbate. Increases in population, automobile and fossil fuel-based engine usage, and development (especially industrial development) within the last five years have resulted in increased ozone levels in South Carolina.

The Environmental Protection Agency (EPA) and the South Carolina Department of Health and Environmental Control (DHEC) regulate and protect air quality within the State. Most of South Carolina, including Greenwood County, is below the threshold for ambient air quality standards. However, increased urbanization in the surrounding Greenville, Augusta, and Columbia metropolitan areas will have future impacts on local air quality in the Greenwood area.

In December 2002, Greenwood County entered into an Early Action Compact with 45 of the State's 46 counties to develop a statewide early action plan to reduce ozone. This statewide agreement encourages county participation in local ozone reduction initiatives. This proactive approach reduces ozone before levels reach critical thresholds at which point the EPA would mandate county implementation of ozone reduction measures. In 2004, Greenwood County entered into an Early Action Compact with DHEC and the EPA for 8-hour ozone standards for the South Carolina Upstate. Objectives were established for the County to reduce ozone emissions during high ozone days. DHEC continues to monitor ozone levels while working with EPA to ensure that Upstate counties meet air quality standards. Greenwood County should continue to analyze these factors in relation to the growing ozone problem and develop local

solutions that manage ozone within acceptable levels that work in-hand with the promotion of development.

Population and traffic are the two key contributors to air quality problems. Greenwood County had 1,200 road miles and 74,094 registered vehicles in 2002. Therefore, land use decisions weigh heavily on long-term air quality conditions. Compact development should be encouraged and the impact on transportation and the number and length of vehicle trips generated should be considered when siting new community facilities. Accommodations for alternative forms of transit should also be made to provide accessible and safe pedestrian and biking routes.

10.6.2 Economic Development

A community's economic development strategy has clear implications for land use, transportation, energy conservation and other local planning issues. Although some degree of economic development can, and likely will, happen by default in any community, only a carefully planned program will advance the type of growth and quality of life desired by residents. Such a comprehensive approach lays the foundation for quality economic development that is balanced with local environmental concerns, renewable and reliable energy sources, cost-effective infrastructure utilization, and sound community fiscal capacity.

Greenwood County's economic health influences virtually every aspect of life for residents – from jobs and taxes to education and quality of life. The County has successfully launched the transformation of its economy into a diversified base of manufacturing, trade, services, education, and health care. Integrating economic development processes with other local planning considerations such as sustainability and energy conservation can diminish fiscal and environmental concerns posed by growth.

Energy efficiency influences all aspects of the local economy and any balanced discussion of energy use and attempts at energy conservation must include the economic sector, especially industrial and commercial interests. The industrial sector is a primary user of energy in Greenwood County, consuming more than a third (39%) of energy distributed annually within all economic sectors. Together, the commercial and industrial sectors consume nearly half (48%) of the energy distributed in Greenwood County each year.

Both direct and indirect impacts of energy investments affect a community's economic health. Direct costs are easily quantifiable as revealed in actual energy expenditures by individual businesses and industries in the form of utility bill payments, equipment purchases and new construction. The indirect investments in energy efficiency, however, are even more far-reaching, stimulating multiple spin-off benefits in the form of additional jobs, services and equipment purchases.

10.6.2.1 Business and Industry Recruitment and Retention

The local economic development strategies of the past two decades have guided the County's successful transition to a manufacturing and service-based economy. Given the success of these efforts, future economic growth offers an opportunity to refine these development strategies to incorporate the concepts of sustainability and energy conservation. Communities are now looking beyond an influx of new jobs in search of a sustainable economic growth strategy that addresses other local concerns such as brownfield redevelopment, education and training, job and wage security, cultural resource enhancement, pollution prevention, natural resources conservation and infrastructure development.

In light of this shifting emphasis from quantity to quality in economic development, many localities are realizing new economic growth opportunities by encouraging businesses in energy efficiency, materials recycling, environmental technologies and brownfield redevelopment. An increasing number of local governments are developing sustainable economic development strategies that focus on advancing their community's long-range development vision. These strategies often include one or more of the following: the development of eco-industrial parks; the encouragement of infill development and revitalization of downtowns; the facilitation of waste recycling and renewable energy use among business and industry; the efficient design and operation of industrial and commercial facilities and production processes; the development of financial incentives for sustainable practices; and the adoption of regulatory streamlining and reform measures by local governments.

10.6.2.2 Revitalization and Infill

Sensible growth initiatives encourage the development of land closer to existing urban development, provide incentives for infill and the redevelopment of previously developed areas, and discourage encroachment of new development into areas that lack the necessary public facilities, services and infrastructure. This strategy facilitates the revitalization of urban centers and contributes to the retention of existing infrastructure investments. The revitalization of existing built properties and the infill of new development on vacant lands within developed areas also produces significant energy conservation benefits. Commercial and employment centers sited in developed areas offer more convenient access to retail stores, governmental services, health care, cultural venues and other amenities – reducing the need for lengthy commutes and encouraging the use of public and alternative transportation.

The redevelopment of existing facilities and build-out of vacant properties within developed areas alleviates growth pressures on community infrastructure. For areas beyond the central business district, planners and local officials can evaluate and pursue appropriate commercial and/or industrial projects within master planned communities. This mixed-use strategy encourages compact development and creates employment opportunities within close proximity to housing, again facilitating alternative transportation and reducing reliance on cars.

10.6.2.3 Industrial Ecology

Industrial park development is a tried-and-true tool for economic development. By providing a designated focal point for manufacturing and other related facilities, such parks inherently contribute to the efficient distribution of energy resources. Water and sewer, natural gas, telecommunications, and electrical transmission lines, along with railways and roads, can be extended to serve a centralized cluster of industries in a single park instead of scattered individual sites.

The traditional industrial park concept is evolving to encompass a more holistic view in which companies are part of a shared industrial ecosystem. This new breed of industrial park is promoted as an approach to reduce waste, improve efficiency, reduce environmental impacts and, ultimately, boost a company's bottom line. Such parks emphasize a bond between manufacturers as part of a common industrial ecosystem for business and environmental excellence with an integrated and sometimes shared network, or ecology, of suppliers, customers, geography and markets.

Eco-industrial development, also known as green industry, offers a practical strategy to implementing sustainable economic development. According to the Center of Excellence for Sustainable Development of the US Department of Energy, the concept centers on the production of economically valuable goods and services while reducing the ecological impacts of production. The location of eco-industrial operations within a mixed-use development offers an energy-efficient, environmentally-sensitive employment option that contributes to a diverse but compatible economic mix. Seven basic criteria for eco-efficient industrial operations have been outlined by the World Business Council for Sustainable Development:

- Reduction of the material intensity of goods and services
- Reduction of the energy intensity of goods and services
- Reduction of toxic dispersion
- Enhancement of material recyclability
- Maximization of sustainable use of resources
- Reduction of material durability
- Enhanced service intensity of goods and services

10.6.2.4 Renewable Energy and Recycling

The development and use of locally renewable energy resources, particularly by the industrial sector, is requisite to curbing the adverse economic and environmental effects of the State's current energy use and consumption patterns. Both businesses and local governments are now recognizing the benefits of capturing the economic and energy-generating potential of waste streams. Many counties, municipalities and regions across the nation are actively assessing the potential of their local waste streams and recruiting employers who can not only create much needed jobs, but can also incorporate what would normally be considered unwanted waste and pollutant by-products into viable components of their production processes and end products.

The sharing of what the originating source considers a waste product with a business or industry who can utilize that byproduct in a productive way not only benefits both parties, it also keeps those materials from ending up in the local landfill. Industrial byproducts that are used in the production of other products minimize public costs for additional landfill space or costly technology to clean the waste for release into the environment. In addition, facilitating the location of these compatible industries within close proximity of one another minimizes the cost and the energy used in transporting the material. In the late 1980s, Greenwood County studied the use of steam generation from landfill material as a means to recycle unwanted materials, generate energy and lower costs to industries located within the County industrial park. Similar alternatives should be reviewed as technological advances make such generation measures more affordable and lessen the overall impacts to the environment.

10.6.2.5 Financial Incentives, Education, and Technological Advances

Although not as clearly within the parameters of local planning, local governments can influence energy efficiency in the areas of industrial and commercial facility site design and construction, facilities management, production processes, and the development and application of new technologies in the workplace. Community concern over industrial and commercial energy savings is warranted, because each dollar that is saved on energy bills can be reinvested into the business and thus, the local economy.

Research has shown that investments in energy efficiency measures yield additional local economic benefits beyond utility bill savings**.** Economic multipliers help to quantify the economic impact of investments to improve efficiency**.** The economic multiplier for payment of an electric bill is only $1.75 per dollar spent, with most of the typical utility bill payment exiting the local economy. Making energy efficiency improvements generates a multiplier of $2.32, or $0.57 more per dollar spent. Investments in energy conservation measures can leverage community economic growth – when local construction firms are used for facility modification and equipment installation and upgrades; when new, energy-efficient equipment is purchased from local vendors; and when energy savings increase a company's productivity and profitability, resulting in business expansion and the addition of new jobs for local residents.

Working in partnership with local employers, communities can mobilize technical assistance, financial incentives, and new technologies to enhance the energy efficiency and, in effect, the economic competitiveness of business and industry. Specific activities by local governments that can encourage efficiency investments by businesses include:

- Establishing partnerships with local utilities and industries to develop energy efficiency and conservation programs that generate cost savings for local businesses;
- Making energy conservation information available through the business licensing and building permit processes;
- Sponsoring workshops on energy conservation practices;
- Conducting energy audits for commercial and industrial facilities;
- Partnering with employers and utility providers to construct demonstration facilities where energy-efficient design principles are put into practice and showcased;
- Assisting local employers with applications for grant and loan programs that help cover the costs of retrofits and the development and implementation of new technologies in the work environment; and
- Facilitating local and regional eco-industrial recycling partnerships for waste by-product incorporation into industrial production processes and energy generation.

10.6.2.6 Regulations and Incentives

Regulation of land use, design, construction and environmental practices is considered integral to ensuring community safety and quality of life. However, cumbersome and prolonged review processes and antiquated regulations can impede the recruitment and cultivation of energy-friendly businesses. Local governments and designated economic development authorities can take the following regulatory and policy steps to stimulate energy-efficient and environmentally sound economic development:

- Conduct surveys and compile a database of existing industrial waste streams and potential users to serve as a basis for focused economic marketing and recruitment;
- Streamline regulations and approval processes, allowing flexibility to accommodate new manufacturing technologies, emerging markets for recycled goods, and the innovative re-use of waste by-products in production processes;
- Pursue federal and state funding opportunities for public and private sector led pilot energy efficiency projects and the development and testing of new conservation technologies and products;
- Involve local business and industry representatives on local energy advisory committees and in the energy conservation planning process;
- Facilitate and foster partnerships among existing and potential industries for waste stream recycling and by-product re-use;
- Work with State officials to identify and secure tax breaks, loans, financing, infrastructure grants and other incentives and work to eliminate existing financial disincentives for desirable industries; and
- Minimize the uncertainties faced by the private sector by clearly linking economic development decisions with the land use planning, zoning, permitting, codes enforcement and inspections functions.

Local governments must undertake economic development decisions within the overall context of other planning functions, including planning, zoning, permit approvals, inspections, housing development, community revitalization, capital improvements and transportation. The community's support for economic development must be reflected in a decision-making process that is clear and consistent. By integrating economic development decisions with their other responsibilities, communities can reduce the regulatory and procedural barriers that often impede the realization of sustainable development objectives.

10.6.3 Housing Opportunities

Nearly 15% of the energy consumed in Greenwood County is attributed to residential use. South Carolina has experienced a 97% increase in residential energy use since 1970, more than twice the national increase. As residential energy consumption continues to rise, its impact on overall energy consumption becomes more significant. Consequently, in order to substantially reduce overall energy use at the local level it is important to include policies and programs that target reductions in residential energy use.

With nearly half of residential energy consumption in the State devoted to indoor temperature control, energy conservation efforts must include measures designed to reduce heating and cooling needs. Since heating and cooling are closely tied to factors such as outside air temperature and wind, it is possible to implement residential construction and development design measures that will result in significant energy savings. Greenwood County is within a humid subtropical region, characterized by hot, humid summers and mild winters. The average annual temperature is 61.3°F, with the average high temperature reaching 73°F and the average low dipping to 46°F. The warmest temperatures are typically recorded in July, while the coldest temperatures usually occur in January. The average heating degree days for the Greenwood area are 3,239 and the average cooling degree days are 1,501.

Development design characteristics such as density and housing type are significant factors in residential energy use. Multi-family and other attached housing units that incorporate shared walls require less energy for heating and cooling. Smaller detached single-family, attached single-family and multi-family homes use less energy for space heating and cooling than larger, more traditional single-family detached homes.

Proper siting of individual housing units can also yield energy savings, with the site orientation of a building having a significant effect on heating and cooling needs. In hot, humid Southern states such as South Carolina, protecting homes from the hot summer sun and assuring good air movement in and through the site are important design considerations. If possible, homes in South Carolina should be oriented to face south or southeast. However, building orientation in residential developments is often

dependent on the street layout, since houses generally face the street. If street orientation is primarily from east to west, either the front or back walls of the homes (the largest sides with the most windows) should face south.

Exterior shading is critical, since it is seven times more effective to cool a building by shading the exterior rather than by interior shading such as blinds or draperies. Trees are one of the most effective ways to keep the sun's rays from entering a building. Through proper placement of a few mature trees, a building can be shaded for most of the daytime hours.

Building construction and materials also play an important role in energy consumption. The Greenwood City/County Building Department adopted and began enforcement of an energy code in 1992. In keeping with State regulations, both the City and the County replaced the 1992 energy code in 2002 with the *2000 International Energy Conservation Code* (IECC). The code requires new dwellings to have insulation with a minimum rating of R-30 for ceilings, R-13 for exterior walls, R-19 for floors (with crawl space) and R-6 for ductwork in unconditioned spaces. Double-pane or single-pane storm windows are also required.

According to Census 2000 figures, approximately 85% of the housing stock in Greenwood County was built prior to 1992 and therefore was not required to meet energy code standards. Since adoption of the energy code in 1992, all new dwellings constructed in the County have been required to meet these standards. With an estimated 1,071 new homes constructed in the County since April 2002, the percentage of dwellings that were not required to meet the energy code has dropped to 82%. As older homes drop out of the housing market and are replaced by new homes, the percentage of the County's housing stock that does not conform to energy code standards will continue to decrease.

Manufactured housing comprises 13.2% (3,977 housing units) of all housing in Greenwood County (*ACS, 2008*). Although manufactured housing has not historically been considered an energy-efficient housing choice, the SC Energy Office launched an energy efficiency certification program in 1998 to promote energy-efficient construction in manufactured housing. Through this program, the SCEO distributes SC Manufactured Housing Energy Efficiency Labels to qualified manufacturers that certify the manufactured home meets or exceeds the energy efficiency levels prescribed in the *South Carolina Code of Laws*. By law, energy labels may only be placed on homes that meet or exceed the minimum requirements for energy efficiency. To meet energy efficiency standards, the home must have storm or double-pane glass windows, insulated or storm doors, and a minimum insulation thermal resistance rating of R-11 for walls, R-19 for floors and R-30 for ceilings, or equivalent allowances. The impact of the program on overall energy efficiency in the manufactured housing sector has been substantial, with an estimated 70% to 80% of manufactured homes meeting the SC Energy Efficiency criteria in 2008 *(Annual Report on the Implementation of Energy Efficient Manufactured Homes Incentive Program SCEO)*. When applied to the manufactured homes in Greenwood County, it is estimated that 2,983 homes meet the Energy Efficiency criteria.

In 2008, the State enacted legislation designed to create more significant incentives for ENERGY STAR labeled homes. These homes are even more energy efficient than those that adhere to the state-specific 1992 energy efficiency criteria. New incentives include the elimination of all sales tax on ENERGY STAR manufactured homes and a $750 nonrefundable state income tax credit for eligible home buyers. These credits are offered in addition to, not in place of, the older energy efficiency sales tax incentive. It is expected that these additional incentives will result in an increased percentage of manufactured homes with the ENERGY STAR label, both statewide and in Greenwood County, in coming years.

10.6.4 Community Facilities

Community facilities have substantial influence on energy usage patterns in a community and provide an effective arena for the introduction and implementation of energy conservation measures. Community facilities include projects and activities essential to a community's sustained growth and development. Utilities, infrastructure, governmental and educational functions are addressed under the vast community facilities umbrella. These functions include the siting, construction and operation of water and sewer service, electric and natural gas, telecommunications access, stormwater management, transportation, solid waste collection and disposal, police and fire protection, health care, emergency medical services, governmental facilities, emergency preparedness, educational facilities, parks and recreation, libraries

and other institutional uses. While community facilities and public institutions are provided and maintained primarily by local governments within the community, some facilities such as roads and educational centers are built and maintained by state or federal governments. Institutional facilities also include hospitals, health clinics, private schools and colleges and other public, non-governmental facilities.

Local governments and institutions are among the leading consumers of energy within a community. This is due in large part to the size of public buildings and facilities, coupled with the fact that such facilities are often older and less energy-efficient. Institutions such as hospitals, police stations and prisons are in operation 24 hours a day and rely on equipment that requires substantial amounts of energy around the clock. Schools and other public buildings have a great deal of traffic in and out of buildings, which significantly increases the heating and cooling needs of such facilities.

As high-profile energy consumers, local governments and service providers have a unique opportunity and responsibility to promote energy conservation through the efficient use of energy within their operations. Local government conservation efforts typically fall into one of six categories: administration, policies and employee education; community facility site selection; building efficiency and site design; facility management; and fleet efficiency.

10.6.4.1 Administration, Policies and Education

Energy costs represent top budget expenditure categories for most local governments. Faced with tightening fiscal conditions and growing public demand for efficiency and accountability, local governments and public institutions nationwide have begun to incorporate energy conservation measures into their policies and procedures.

Local governments and institutions can realize significant energy savings by revising policies and operational procedures to make energy conservation a high priority. Through the adoption of policies such as office recycling, local governments and institutions can save energy, reduce costs, and serve as examples to the community. Efforts can range from the recycling of common office waste such as paper and plastic to the production of energy from landfill gases. The following are common steps for local governments or institutions in developing and implementing an effective energy conservation program:

- Designate a lead office for the energy planning effort.
- Conduct an energy assessment.
- Identify major institutional goals and issues related to energy conservation.
- Build support from all departments and coordinate activities.
- Identify and analyze energy plan options.
- Write and adopt an energy-efficiency plan.
- Establish a fund for upfront costs for energy efficiency improvements.
- Implement the energy-efficiency plan.
- Monitor progress, evaluate programs and update strategies.

10.6.4.2 Site Location

Facilities planning for governmental and institutional uses should incorporate sound energy conservation principles not only in building design, but in site selection processes as well. Because of the physical nature of community facilities, such planning has substantial influence on the type and direction of growth as well as the potential for redevelopment of an area. Locating new buildings or facilities near transit, bicycle and pedestrian facilities will encourage the use of alternative modes of travel. Close proximity of facilities to other related uses, along with adequate pathways, will decrease vehicular travel between facilities. For example, location of county fueling stations near vehicle intensive departments such as public works or the sheriff's department can reduce travel. Also, many local governments and institutions are major employment centers. When they are located near retail, restaurants, childcare and other essential services, employees are more likely to use alternative modes of transportation.

Governmental and quasi-governmental organizations – federal, state, regional and local – can have considerable influence on a community's long-term energy efficiency through site selection decisions for public facilities. The location of federal post offices, federal and state courthouses, state health and social services offices, regional transportation centers and routes, federal and state corrections facilities, post-secondary institutions, and other essential facilities can either complement or derail community

development plans. Perhaps the most significant, but often overlooked, example of the importance of site selection is the location of new schools. Recommendations on improving the site selection and design process at the local level to facilitate energy conservation include:

- Include local jurisdiction planners in meetings with school facility planners and developers to ensure compliance with local comprehensive plans;
- Initiate formal review and comment process for local jurisdictions on proposed school sites and designs;
- Ensure coordination between local planners and school district officials on school site design and linkages to existing transportation networks to encourage walking and biking opportunities; and
- Prepare transportation cost-benefit analyses of proposed school sites to strengthen decision-making process.

When carried out in coordination with the community land use plan, school siting can strengthen local development and energy conservation goals. Schools built within close proximity of existing residential areas encourage alternative modes of travel such as biking or walking and require shorter vehicular trips. When schools are located near essential services such as dry cleaners, day care centers, and health providers such as dentists and doctors, fewer trip miles are needed to reach multiple destinations.

10.6.4.3 Site Design and Building Efficiency

The potential for energy savings in local government and institutional facilities is significant. Energy savings equate to dollar savings as well. The money saved through energy conservation measures can be redirected to meet the pressing fiscal requirements of other administrative, operational, programmatic and facilities infrastructure needs.

Site design and building orientation influence energy use. When possible, new construction and additions should be oriented to take advantage of solar heating in the winter, while maximizing prevailing breezes to reduce air temperatures in warm-weather months. Landscaping should be incorporated to provide shading and reduce ambient air temperatures in the summer. During colder months, landscaping can also divert winter winds by acting as wind breaks.

Energy savings can also be realized through either retrofitting existing facilities with energy-efficient technologies and designs or by encouraging energy-efficient design and the use of energy-efficient technologies in new buildings. It is important to include energy savings as a factor when considering return-on-investment for either retrofits or new construction. Determining potential energy savings for the retrofit of existing buildings requires a comprehensive energy audit.

Several notable efforts have been implemented at the local level. *Piedmont Technical College* has participated in several energy conservation assistance programs administered by the SC Energy Office, with projected savings of more than $126,980 in energy expenditures within ten years of the completion of each project. Project activities included retrofits of major campus facilities, with projects completed in 1994, 1996 and 1997. As a requirement of participation in SCEO energy conservation programs, Piedmont Tech is also a partner in the *Rebuild South Carolina* program. The SCEO provides a walk-through energy use audit for *Rebuild South Carolina* partners to assess the energy costs and efficiency of facilities by analyzing energy bills and conducting a brief survey of the structure. Assistance in the development of an energy conservation plan is also provided, along with advice on funding options and monitoring of energy savings realized through conservation initiatives.

Greenwood School District 51 participated in the SCEO *Schools Lighting Grant Initiative*. Under this program, energy efficient lighting was installed at Ware Shoals High School and illumination levels were brought into compliance with the *SC School Facilities Planning and Construction Guide*.

The Greenwood County Library was opened in October 2010 on South Main Street. This new facility is constructed on a brownfield site in Uptown Greenwood. The new facility includes expanded areas for book stacks, reading, special collections and staff support. New services supported by dedicated space include a children's work room, a teen center, public computers, and a large community meeting space.

The new Library design is LEED Certified (Silver) and focuses on improving indoor environment quality by utilizing low VOC materials and installing high performance air supply systems, reducing water usage through the installation of low-flow plumbing fixtures and a water-efficient landscape, and the use of recycled and regional building materials.

Greenwood County has made a number of changes and improvements to County facilities in recent years to promote energy savings and conservation. For instance, HVAC upgrades have resulted in significant energy savings for County facilities. The replacement of a 1966 vintage boiler and air conditioning system in the Courthouse resulted in reductions of almost 40% in energy usage and annual utility expenses. These savings were realized despite the addition of more than 50 computers to the building. The savings were achieved by dividing the existing ductwork into zones and replacing the large whole-building AC units with separate gas heat and AC units for each zone. Economizers were installed on most of the new units to further aid in energy reductions by using outside air to meet cooling needs when the temperatures are appropriate. At the Park Plaza facility, new HVAC units were installed that utilize gas heat and air conditioning to replace the existing air conditioners with electric duct zone heat. Units were divided by floor to eliminate multi-zone cooling by using individual zone reheat operations, resulting in a 20% reduction in energy use. In the Civic Center, existing electric duct heaters formerly on a central control were replaced by gas duct heaters with four zone controls, resulting in a more evenly dispersed heating system with less overheating in any zone due to spectator body heat when only one or two sections are used. Lighting upgrades also resulted in reduced energy consumption in County buildings. The main courtroom in the Courthouse underwent a relighting project using metal halide fixtures in an indirect lighting scheme that has reduced the lighting load while improving ambient light levels in the courtroom. Older mercury vapor lighting systems in the Sports Complex were replaced with high efficiency metal halide fixtures to improve lighting levels and reduce electrical consumption.

Figure 10-51. ARRA Funded Energy Projects in Greenwood County, 2009

Organization	Award Amount	Project Description
Local Governments		
Greenwood County	$104,416	Install energy efficient windows and insulation in the Brewer Community Center
City of Greenwood	$147,011	Install energy efficient heating and air conditioning equipment and lighting
Town of Ninety Six	$ 17,032	Install energy efficient heating and air conditioning equipment in the Senior Center, Community Center and Town Hall
Town of Ware Shoals	$115,500	Install energy efficient heating and air conditioning equipment and hot water heater in Town Hall
Public School Districts and Public Colleges and Universities		
Greenwood County School District 50	$248,337	Change lamps and ballasts at Career Center and District Office; install new windows and HVC at ISC; Install EMS at Springfield School
Greenwood County School District 51	$ 73,749	Replace existing natural gas heating boiler and winder A/C units with new 13 seer wall mounted head pumps with DDC controls
Greenwood County School District 52	$ 79,569	Install new energy management system and retrofit lighting at Ninety Six Primary School; retro commissioning of systems at Ninety Six Elementary School
Lander University	$232,000	HVAC controls upgrade and library lighting – Jackson Library; water heater upgrade – Grier Center
Piedmont Technical College	$115,850	Install automatic lighting controls in classrooms campus-wide and replace 3 HVAC units

10.6.4.4 Facilities Management

A number of local governments and public institutions have been awarded funding to improve energy efficiency under the *American Recovery and Reinvestment Act* (ARRA) of 2009. Greenwood County, the City of Greenwood, and the Towns of Ninety Six and Ware Shoals received funding for energy efficiency projects under the Energy Efficiency and Conservation Block Grants (EECBG) program that provided stimulus funding for state and local governments. Greenwood School Districts 50, 51 and 52, Lander University and Piedmont Technical College received funding for energy projects under the State Energy Program (SEP), which provided stimulus funding for public school districts, public colleges and universities, and state agencies. Greenwood County AARA energy projects are profiled in Figure 10-51.

Energy use in community facilities varies widely and is dependent on factors such as the number and age of buildings and facilities, climate, and types of activities conducted. Although it is difficult to develop an overall picture of energy use by local government and institutional facilities such as hospitals, energy consumption and cost data is available for school districts, state agencies and public institutions of higher education in South Carolina. The South Carolina Energy Office (SCEO) compiles energy data on an annual basis, focusing exclusively on energy use by buildings and fixed facilities. Transportation-related energy use and costs are not included in the annual report. In addition to the categorical profiles outlined in the SCEO report, each institution, district and agency receives a customized report from the Office that details energy costs and usage per square foot and provides comparisons to the facility averages in each category. The data also enables the SCEO to identify institutions and individual structures with unusually high energy usage and/or expenditures. This data can then be referenced against the detailed, building-by-building data provided by each institution to locate specific problems.

An assessment of energy usage is an essential tool in the effort to reduce energy use. Periodic energy use assessments of equipment, systems and maintenance practices will uncover inefficiencies and provide the data necessary to recommend and evaluate needed upgrades and retrofits. These assessments should include larger systems and facilities such as water and wastewater facilities, HVAC and computer systems, and road maintenance and landfill equipment. Energy use by smaller systems such as lighting systems for individual buildings and landscaping equipment should also be addressed.

Routine maintenance of most mechanical and electronic equipment can save energy. Staff should be trained in proper maintenance techniques and methods, with on-going updates on new technologies and procedures. To encourage staff participation and interest, rewards or recognition can be used to acknowledge employees who go the extra mile in conserving energy. A standard methodology for tracking energy use and comparing actual performance with conservation goals should be developed early on to both inform and motivate employees.

10.6.4.5 Fleet Efficiency

Many local governments and institutions operate and maintain a fleet of vehicles. Although these fleets vary greatly in size and composition, they present a prime opportunity to institute energy saving measures. Local governments and institutions can save significant amounts of energy and money by increasing the fuel efficiency of individual vehicles, operating vehicles more efficiently, and improving overall fleet management practices. There are numerous opportunities for local governments and institutions to make fleet operations more energy efficient including:

- Implement a management information system to closely track maintenance schedules, fuel consumption, mileage, fuel costs and other related information.
- Assign vehicles appropriate to the task.
- Purchase fuel-efficient and appropriately-sized vehicles.
- Practice preventative maintenance such as keeping tires properly inflated.
- Train maintenance staff in practices that improve fuel economy.
- Train drivers in fuel-efficient driving techniques.
- Centralize fleet operations to achieve an economy of scale, improve maintenance efficiency, and more effectively implement fuel efficiency programs.

- Automate fueling stations to track fuel efficiency, schedule preventative maintenance, and discourage excessive personal use of fleet vehicles.
- Explore use of alternative fuel vehicles.

10.6.5 Transportation Opportunities

During the past century, no single force has had a greater impact on the pattern of land development in American cities than transportation. Improved roadways and affordable cars have enabled families to relocate from housing near their workplaces to homes in the suburbs that provided more housing per dollar in the form of larger lots, detached houses, and cleaner environments. In turn, retailers followed their customers to the suburbs and service-oriented firms then followed the retail and manufacturing firms they serve to the suburbs. In short, transportation improvements have been a major factor in the exodus of households and businesses from urban areas to the suburbs.

If improvements and additions to transportation systems are designed with energy conservation in mind and implemented in conjunction with effective land use policies, substantial energy savings can be realized. Options for reducing transportation energy consumption include:

- Shifting traffic to more efficient modes, by lowering the Btu per seat miles (from auto to buses, mass transit and human powered sources);
- Increasing load factor, by raising the passenger mile per seat (carpooling and vanpooling);
- Reducing demand, by reducing passenger miles (through land use planning, telecommunications and other methods);
- Increasing energy conversion efficiency, by lowering the Btu per seat mile (smaller and more efficient vehicles); and
- Improving use patterns, by lowering seat miles (traffic design and control).

Although residential development in Greenwood County has begun to shift outward into rural areas in recent years, a large percentage of the population remains within the urban and suburban area of the County. While Greenwood County residents on average enjoy the shortest commutes in the State, with a mean travel time to work of only 20.3 minutes, they are also highly dependent on the automobile for transportation. Nearly 82% of Greenwood commuters drive alone to work – higher than the 79.4% of workers statewide and 75.7% of workers nationwide who travel solo to work. More than 8% of Greenwood workers carpool to work – lower than both the State and national percentages of 10.9% and 10.7%, respectively. Slightly over 2% of Greenwood commuters walk to work, reflecting a percentage similar to the statewide average of 1.8% but slightly lower than the nationwide percentage of 2.8%. Perhaps the most significant statistic related to travel to work is the use of public transportation or other alternative modes of transportation (taxi, bicycle, motorcycle, etc.) within the County. Only 1.1% of Greenwood workers travel to work by taxi (the only form of public transportation available in the County) or an alternative mode of transportation – lower than the percentage of South Carolina workers at 2.5% and much lower than the percentage nationwide at 6.8%.

Figure 10-52. Travel to Work for Workers 16 Years and Older, 2008
Greenwood County, South Carolina and United States

Travel to Work	Greenwood County	South Carolina	United States
Mean Travel Time to Work (minutes)	20.3	23.2	25.5
Drove Alone	81.5%	79.4%	75.7%
Carpooled by Car, Truck or Van	8.3%	10.9%	10.7%
Walked	2.1%	1.8%	2.8%
Public Transportation, Taxi, Motorcycle, Bicycle, or Other Means	1.1%	2.5%	6.8%

Source: US Census Bureau, 2008 American Community Survey.

While traffic congestion is not a serious problem in Greenwood County at present, there are some emerging areas of concern. In the *2000 Thoroughfare Plan for Greenwood County*, the SC Department

of Transportation (SC DOT) indicated that portions of Emerald Road (S-236), S-100, SC 34, SC 10, SC 246, US 25/178 Bypass, and SC 72 Business will all experience capacity deficiencies (congestion) in coming years. The SC DOT also notes that an increase in vehicle miles traveled (VMT) is a major contributor to traffic congestion. VMT is calculated by multiplying Average Annual Daily Traffic (AADT) by the centerline road miles for an area. Vehicle miles traveled in Greenwood County increased by 5% (or 41 million VMT) from 2000 to 2007, as compared to a statewide increase of 12.2% in VMT. This additional 41 million VMT on County roads has likely contributed to the congestion on routes identified in the County Thoroughfare Plan.

Figure 10-53. Vehicle Miles Traveled, 2000-2007
Greenwood County and South Carolina

	2000	2007	% Change 2000-07
Greenwood County	826,041,355	867,358,256	*5.0%*
South Carolina	45,538,000,000	51,109,000,000	*12.2%*

Source: District 2, SC DOT, September 2010; and US BTA, 2008 and "SC Transportation Profile," 2000.

The EIA estimates that nearly 73% of the transportation sector energy usage is expended by automobiles and trucks. Automobiles are responsible for a large portion of the total energy used because they are very energy intensive. As shown previously in Figure 10-34, travel by automobile or light truck consumes more energy per mile than all other modes of ground transportation except light rail systems. Local bus systems and vanpools use less than one-third the energy of automobiles and less than one-fifth the energy of light trucks. Energy savings are even more dramatic when compared to travel on foot or by bicycle. Bicycle travel uses 25 times less energy than automobile travel, while walking uses 9 times less energy. These energy savings are even more significant when you consider that walking and bicycling rely on energy produced by the human body – not fossil fuels. Additional energy savings can be realized per person when the mode of travel is capable of transporting larger numbers of people (buses or rail systems), or even when an automobile or light truck transports more than one person per trip.

The fuel efficiency of passenger cars and trucks continues to improve. The increased availability of more fuel efficient vehicles due to CAFE standards applied on a fleet-wide basis for each manufacturer, in conjunction with rising fuel prices, have contributed to a growing demand for these vehicles for public and private sector fleets as well as by the general public.

Alternative fuel vehicles (AFVs) designed to operate on at least one alternative fuel are increasingly being used in place of gasoline and diesel fuel made from petroleum, as these vehicles and appropriate fuel become more readily available. A key AFV fuel is ethanol, which is a renewable resource fuel produced by fermenting and distilling starch crops that have been converted into simple sugars. Feedstocks for this fuel include corn, barley and wheat. Ethanol can also be produced from "cellulosic biomass" such as trees and grasses and is called bioethanol. Ethanol is most commonly used to increase octane and improve the emissions quality of gasoline. Higher blends of ethanol, specifically E85, are becoming more available in certain regions of the United States. All of the major automobile manufacturers have models that can operate on E85, gasoline, or any mixture of the two.

Hybrid electric vehicles (HEVs) are powered by two energy sources – an energy conversion unit (such as a combustion engine or fuel cell) and an energy storage device (such as batteries or ultracapacitors). The energy conversion unit may be powered by gasoline, methanol, compressed natural gas, hydrogen, or other alternative fuels. HEVs have the potential to be two to three times more fuel-efficient than conventional vehicles.

In the fall of 2010, a telephone survey of local automobile dealerships was undertaken to estimate how many alternative fuel vehicles were operating within Greenwood County. The four dealerships in Greenwood County were contacted, representing major manufacturers including Chevrolet, Cadillac, Chrysler, Dodge, Jeep, Toyota, and Nissan. Of the dealerships contacted, two indicated that they had not stocked or sold any alternative fuel vehicles to date. One dealership, Ballentine Toyota, reported selling approximately 30 hybrid vehicles in 2009. Quality Dodge-Chrysler-Jeep indicated that while they did not sell any hybrid vehicles in 2009, they sold 60 flex-fuel vehicles, which operate on gasoline or E-85

ethanol, or any combination of the two fuels. It is also possible that Greenwood County residents have gone outside of the County to purchase other alternative fuel vehicles from manufacturers such as Ford, Honda and Mazda or that some AFV's sold by the dealership were purchased by users outside the County – making it difficult to estimate how many of these vehicles are actually operating within the County.

10.6.5.1 Street and Parking Design

The evolution of street design in the United States has primarily been a product of a growing population's increasing dependence on the automobile. As traffic volumes increased, road design standards were modified to make auto travel more safe and efficient, often at the expense of the character of residential areas. Standards required streets wide enough to accommodate increased traffic, turning radii large enough for service and emergency vehicles to negotiate cul-de-sacs, and T-configured intersections that minimized traffic conflicts. Traditional grid systems fell out of favor because they allowed through traffic on residential streets, while cul-de-sacs were encouraged because they prevented such through traffic. In addition, parking standards were designed to accommodate the maximum number of automobiles needed for each land use category, with little consideration for shared parking, carpooling or alternative methods of travel, shift changes, number of employees, or the unique needs of individual businesses or industries.

It has become apparent that many of these practices, while providing solutions to some problems, have created many others. Unnecessarily wide streets encourage faster speeds, discourage walking or biking, increase the percentage of impervious surface, and increase ambient temperatures. Poor connectivity often restricts the viability of other transportation modes, making driving the most attractive travel option. Cul-de-sacs lengthen distances for travelers, discourage pedestrian travel, and make transit service more difficult to operate and use while placing an added financial burden on local governments that must provide emergency, safety and maintenance services. Wide intersections and the placement of sidewalks adjacent to travel lanes make negotiation by pedestrians and cyclists difficult. Expansive parking lots increase impervious surfaces, make walking prohibitive, increase ambient temperatures, and are often underutilized.

The problems associated with conventional street and parking design ultimately result in increased energy usage. Street design that encourages and enables alternative modes of travel not only saves energy, but can also enhance the overall character and livability of an area. Alternative means of transportation can be made safer and more attractive by redesigning streets and intersections within intensively developed areas to give equal priority to pedestrians, cyclists, buses and automobiles.

Substantial energy savings can also be realized by sizing streets to accommodate their use. Retaining higher speed street designs and capacities outside intensively developed neighborhoods and developments allows driving speeds to be sustained where they will not endanger residents. A system of interconnecting streets of varying designs can provide multiple routes that diffuse traffic congestion by keeping local traffic off regional roads and diverting through traffic away from local streets.

Automobiles are most efficient when operated at steady, relatively low speeds (35-45 mph) with no stops. Optimizing the timing of existing signals and installing advanced control equipment can significantly reduce traffic congestion and fuel use. Conversely, increasing the number of stops and slow-downs or decreasing the average speed below optimal levels will increase energy consumption.

Steps can also be taken to make parking areas more energy-efficient. To avoid excessive parking requirements, realistic parking needs can be determined by more closely examining the needs of specific use categories. The incorporation of shared parking in mixed-use developments can reduce parking demand. Parking design and placement are also critical factors. Lots should be placed and configured to encourage, rather than discourage, pedestrian travel to nearby businesses or residences. The addition of trees and other landscaping features can reduce ambient temperatures in parking lots in addition to making them more visually appealing for pedestrian use.

The Thoroughfare Plan developed for Greenwood County and its municipalities identifies current and future carrying capacities of all roadways. The Plan also identifies areas for new construction and

expansion of existing facilities, with the goal of greatly reducing travel times. Level of service indicators have been used to model the actual travel patterns within the County. A priority list of upgrades for use as funding becomes available has also been developed that identifies actual costs for improvements.

10.6.5.2 Multi-modalism

Sensible development practices encourage people to use alternative modes of travel – biking, walking or using transit – by providing safe routes to destinations. Interconnected streets reduce distances between points and make destinations easily accessible by multiple methods of travel. Although the option of driving to a destination still exists, better connections make the choice of an alternative mode for shorter trips much more appealing. In some commercial areas connections between adjacent buildings can be so poor that patrons are forced to return to their cars, drive back out to an arterial road, travel a few hundred feet to the adjacent parking lot and park again to reach a neighboring building.

Most modern development patterns maximize convenience and safety for the automobile driver, but not for the pedestrian or cyclist. Today's suburban pedestrian must often travel a route five times longer than the direct distance to their destination. For people to choose to walk or bike on neighborhood streets they must feel as welcome and safe as those who choose to drive. Streets designed with many different users in mind encourage non-vehicular travel. Without a comfortable and safe environment for all users, people will continue to rely on the car for trips to and from home. The key principle to follow in designing successful multi-modal road systems is balance – ensuring the safety and quality of the street environment for all users.

South Carolina's mild winters and moderate temperatures throughout most of the year make walking a popular activity among residents. There is substantial evidence that if safe and adequate facilities are provided, many people will choose to walk to work, to run errands, and to obtain personal services. In addition to safety factors, field studies have shown that the level of aesthetic interest is a critical factor in choosing a walking route. People are unwilling to walk farther than 300 feet through a parking lot to reach a desired destination, yet they will walk at least three times that distance along a street of storefronts.

Bikeways are most successful in reducing automobile travel in communities where development is compact and a mixture of land uses is encouraged. Although cycling for transportation and recreation is widespread, it is most popular in areas with relatively gentle terrain and in areas with a large student population such as a college or university. Bicycle paths should be physically separated from roadways whenever possible, and clearly marked by striping and signage when located adjacent to automobile travel lanes. Intersections and bridges should be designed to safely accommodate bicycle access where needed. To be effective, pedestrian walkways and bike paths should be continuous, linking areas and activities on the site and connecting to locations and paths adjacent to the site.

Most Greenwood residents commute by car because it is convenient and provides reliable on-demand, door-to-door service, usually in a timely manner. To be seen as a viable alternative to car travel, transit must provide a similar service. Many factors can encourage transit use, including traffic congestion, close proximity to home and work, ease of use, safety, reliability, timely delivery, and affordability. Transit systems are most convenient and yield the greatest energy and environmental benefits when a rider's origin and destination are located within walking distance of the transit station or stop. By placing more housing near existing and planned transit stations and stops, more people are likely to use transit and will walk to the station, rather than drive. It is just as critical for efficient provision of transit opportunities that work sites be located within walking distance of transit service. At present, there is no public transit system in Greenwood County.

10.6.5.3 Travel Alternatives

Advances in technology have resulted in new ways to reduce vehicular traffic and conserve energy. While 672 Greenwood County residents reported working from their homes in 2008 *(ACS, 2008)*, improvements in communications and technology have the potential to produce significantly more home-based workers in the future. While many of these workers operate their own businesses from their homes, a growing number of companies are instituting telecommuting as a work option for their employees. Telecommuting is a growing practice in which employees work at home and communicate with the office by telephone, computer and fax. Some telecommuters do all of their work from their home,

while others work part of the week at home and part at their place of business. Each day an employee telecommutes or works at home eliminates at least one round trip.

Teleconferencing can also reduce work-related travel by removing the need to travel for meetings and training. Participants use telephone, computer modems, cable or video technology to hear and view other participants and to view presentations or other materials and exchange data and documents. The benefits of teleconferencing for employers include higher meeting attendance and increased participation, elimination of costly trips, less time away from the job for participants, and greater scheduling flexibility. These technologies can be utilized by individual companies, businesses, agencies, educational institutions, hospitals, and local governments. However, a more cost-effective way to encourage the incorporation of this technology into a wider range of operations is to develop community teleconferencing centers. Such facilities can be developed through public/private partnerships to include local government, universities and community colleges, K-12 schools, government agencies, community-based nonprofits, and private businesses and industries. A number of public institutions and private enterprises within Greenwood County have teleconferencing capabilities including Piedmont Technical College, the Upper Savannah Council of Governments, Self Regional Healthcare, Lander University, Capsugel/Pfizer, Fuji Photo Film, and the James Self Genetics Center. The potential for development of local partnerships and sharing of teleconferencing resources is very promising and should be explored along with the potential market for such facilities by other community groups and enterprises.

Many communities are also encouraging employers to develop work schedule strategies that will help to reduce traffic congestion. Traffic congestion leads to reduced travel speeds, which results in excessive energy consumption. Alternative work schedules can reduce traffic congestion and energy consumption by shifting commuters out of the peak travel periods and eliminating commuter trips. With "compressed work weeks" employees work more than 8 hours a day for 4 days in order to take the fifth day off – resulting in the elimination of one round trip per week. "Flex-time" scheduling allows workers to set their schedules depending upon their needs, with certain core hours when they must be at work. "Staggered work hours" can be used to reduce peak congestion by staggering start times of employees. Both flex-time and staggered work hour programs can reduce the number of workers commuting during peak travel times, although such programs may limit ridesharing opportunities.

10.6.6 Land Use Planning Opportunities

The population of Greenwood County is steadily becoming more urban, with the rural population of the County dropping from 65.1% in 1990 to 44% in 2000. However, the rural population of the County in 2000 was significantly higher than the rural population both statewide at 39.5% and nationwide at 21%. The County ranks 20th among the State's 46 counties in population but only 38th in land area, with a population density that is the 15th highest in the State at 150.5 persons per square mile *(ACS, 2008)*. Population density statewide is slightly less at 148.8 persons per square mile.

As Greenwood County continues the transformation from a rural to a more urbanized area, its land use policies and programs will have a profound impact on the community energy consumption rate. The Florida Center for Community Design and Research estimates that more than half of the energy use of industrialized countries is related to land use distribution – that is, to the spatial relationships of residences to work sites, schools, shopping and other activities. A variety of land use planning tools and methodologies have proven to be effective energy conservation measures. While some involve the development of new policies or regulations or the provision of incentives, others can be accomplished through revisions to existing regulations that address mixed-use and infill development, redevelopment of existing sites, full utilization of existing infrastructure, and compact development.

10.6.6.1 Mixed-Use Development

The location of stores, restaurants, offices, residences, schools, recreation areas, and jobs within close proximity lessens reliance on the car and encourages alternative modes of travel. Such "mixed-use" development results in greater independence of movement for non-drivers such as the young and the elderly and provides access to support service for the growing number of people who work at home. Residents under 16 years of age comprise an estimated 21.5% of Greenwood's population, while residents aged 65 and older make up 23% of the County population *(ACS, 2008)*. Mixed-use

development can also provide a variety of housing choices for a range of age groups, family types and income levels – contributing to a diverse and vibrant community.

Mixed-use developments that combine residential and commercial uses encourage pedestrian and bicycle travel both for shopping and to work, reducing personal vehicle trips. The length of trips by home-based workers to business services and suppliers can be shortened in developments that mix residential and commercial uses, allowing some of these to be made on foot or by bicycle. In addition, advances in technology have resulted in an increasing number of industries that produce no noxious smells or sounds, making them more compatible neighbors to both commercial and residential uses.

Developments that include employment centers, shopping and personal services can produce significant energy savings. With services such as convenience grocery stores, restaurants, dry cleaners, banks, post office and mail centers, childcare centers and pharmacies located near the workplace, commuters can take care of errands without driving elsewhere for these services.

Residential developments that include a mixture of housing densities and types are more energy efficient than conventional single-family housing developments. Incorporating a variety of compact housing types such as multi-family, townhouses or patio homes in a development can result in substantial savings in energy for heating and cooling and in automobile-related energy use when compared with conventional single-family developments.

Building and site design are critical to the energy efficiency of mixed-use developments. Safe, attractive and convenient pathways should be provided that link residential, commercial and employment both within the site and with appropriate adjacent uses. To encourage walking within the development, parking for commercial uses should include a pedestrian circulation pattern that allows customers to park once and visit several locations on foot. It is also important to carefully balance considerations such as noise, aesthetics, and traffic impact to ensure that increased co-mingling of land uses is indeed beneficial to the community.

10.6.6.2 Infill and Redevelopment

Of all the sustainable growth strategies that can be undertaken in a region, strengthening existing, central urbanized areas is one of the most critical. Successful downtowns offer an attractive pedestrian environment, including a complementary mix of uses that generate activity throughout the day and into the evening. Revitalization efforts seek to maximize the use of available properties in urban areas, resulting in more productive use of these strategically located centers and reducing the need to convert greenfields into suburbs. However, healthy urban areas and suburbs are not mutually exclusive. A strong central city should have a positive effect on the whole region. By combining a mixture of uses, higher densities, efficient use of existing infrastructure, and multimodal transportation opportunities, urban areas play an important role in reducing per capita energy consumption.

The trend toward developing outward into traditionally rural areas impacts older suburbs as well. As growth extends past older suburbs, buildings are often abandoned. A current example is the tendency of some “big box” retailers to vacate smaller, relatively new buildings and move to newer, larger facilities located even further from established areas. A successful community revitalization effort should address these older suburbs as well as the urban area.

Many residential neighborhoods and commercial areas, both old and new, have been under-built, leaving empty, overgrown and unkempt lots that create gaps between buildings. Though these vacant, abandoned or derelict properties in established residential and commercial areas often appear to be liabilities to the community, they provide prime opportunities for energy conservation. Infill development makes use of properties within established districts that were initially bypassed, created by demolition, or abandoned for new development. Infill developments contribute to energy conservation on multiple levels. Higher density infill developments promote travel alternatives such as walking and bicycling and help sustain nearby mixed-use development. Infill development also utilizes existing infrastructure, reducing the need to expend additional energy and funds in the expansion or construction of new support facilities.

Properties that include abandoned or derelict buildings are rarely thought of as desirable sites for new development, since the added demolition and cleanup costs often make redevelopment prohibitive. Redevelopment of such sites, known as brownfields or greyfields, is often complicated by the existence of real or perceived environmental contamination. Brownfield redevelopment is a strategy for returning such lands to productive use that results in energy and financial savings as well as improved public and environmental health. Brownfield redevelopment contributes to the local economy and may also attract additional development to an underutilized area. As with infill development, redevelopment can decrease energy consumption and public cost by utilizing existing infrastructure and preventing further encroachment into greenfields.

Redevelopment also includes the innovative reuse of existing facilities. For instance, many "dead" retail malls have been converted into schools, churches, government facilities, offices and heath care facilities. Local adaptive reuse of older buildings has been particularly successful in the City of Greenwood, where the former Greenwood High School was converted into the Greenwood High Apartments. On Oregon and Maxwell Avenues, major façade and streetscape upgrades, including the reuse of the Federal Building, have transformed this section of Uptown into an Arts and Entertainment District which has generated a significant impact in the local economy.

10.6.6.3 Compact Development and Clustering

The introduction and encouragement of compact development and clustering in a community can significantly impact local energy usage. The fundamental concepts of compact development and clustering are similar, but distinct in application. *Clustering* is a development design technique that concentrates buildings in specific areas on a site to allow the remaining land to be used for recreation, common open space, or the preservation of historic or environmentally sensitive features. A *compact development* is one that is built at optimal density and does not necessarily include the provision of open space. Compact development concepts are generally used within cluster projects to maximize buildable space and ensure the adequate provision of open space.

While the concepts of compact development and clustering can be applied to commercial or industrial projects, they are most often associated with residential development. Compact residential development can be achieved by building homes on smaller lots, incorporating provisions for zero-lot-line design (patio homes), building attached homes (duplexes or townhouses), or building multi-family structures (apartment buildings). Clustering is best suited for suburban or rural areas where there are available properties of adequate size to accommodate the required open space. Compact development is best applied to projects in urban areas where properties are generally too small to include significant amounts of open space.

When compared with conventional subdivisions, compact and cluster developments are more energy-efficient. Compact development shortens trips, lessening dependence on the automobile and reducing levels of fuel consumption and air pollution. Residential clustering can reduce the length of streets and utility line installations, saving energy in the construction and later in the maintenance of streets, the transmission of electricity and water, and the provision of services including garbage collection in both compact and cluster developments. In addition, the increased vegetation and open space preserved in cluster developments contribute to a reduction in summer air temperature and cooling needs.

The smaller detached single-family, attached single-family and multi-family homes characteristic of compact development use less energy for space heating and cooling than traditional single-family detached homes. Shared walls in attached and multi-family units reduce heating and cooling losses, resulting in even greater energy efficiency. Compact developments also make more efficient use of urban services by accommodating more residents in less space than a typical subdivision design.

Locally, Greenwood City and County Councils revised their zoning ordinances to include an allowance for cluster developments. This proactive approach allows residential development to cluster all the density in one area of the property while leaving the remaining area undisturbed. Essentially, the developer is given an option to transfer the allowable densities of the entire property into a smaller portion with more dense development to save on infrastructure costs as well as leave the remainder of the property undisturbed.

10.7 Local Renewable Resources Potential

As dependence on conveniences such as cars, air conditioning, and technology grows, the continued search for alternatives to the nonrenewable fuel sources which we are rapidly depleting becomes more critical. The use of renewable energy sources reduces dependence on imported energy. A renewable resource is a natural, but flow-limited, resource that can be replenished. Despite some constraints in the use of renewable resources, they hold the most promise for cleaner, more efficient energy production.

In a time of continued political and economic uncertainty and growing conflict in areas of the world that have historically been key providers of oil, it is crucial that communities seek ways to reduce dependence on imported energy. Developing local renewable resources such as geothermal, solar and biomass will reduce the need to import non-renewable supplies, thus strengthening and adding stability to the national and local economy. Such efforts will also lessen the vulnerability of the Greenwood community to outside supply disruptions and price fluctuations.

Scientists have been working to develop renewable resources that can be used for large-scale applications such as powering cars and heating and cooling buildings. There are many sources of renewable energy available nationwide, although due to geography and climate some of those sources are not applicable to the Greenwood County region. The prevailing winds in South Carolina are not sufficiently sustained or of enough force to make the use of wind generation viable. Although hydroelectric power is used throughout the State to generate energy, development of new hydroelectric sources is usually not feasible, given the prohibitive costs for facility construction and increased environmental concerns and regulations. Although generation of energy through geothermal wells is possible in the western United States due to the proximity of magma close to the earth's surface, this is not the case in the southern region of the country. Given geographic conditions and environmental constraints, the most feasible renewable energy alternatives for the Greenwood region are solar, biomass, and geothermal energy.

10.7.1 Solar Energy

Photovoltaic (PV) cells convert sunlight, the world's most abundant energy source, into electricity, one of the most versatile forms of energy. The SC Energy Office notes that photovoltaic cells have the potential to be one of the most useful of the renewable energy technologies. Photovoltaic, or solar, cells absorb sunlight and convert it directly into electricity – without the use of any moving parts. Since individual cells produce only a small amount of electricity, cells are linked together in solar arrays to produce large amounts of electricity. Cells or arrays are mounted on a roof or on platforms to maximize exposure to the sunlight. The photovoltaic cell produces a direct current, which can be used to operate motors and lights or to maintain the charge in a storage battery so that power can be available during periods when sunlight is not present.

In the US and other urbanized countries, solar arrays can be mounted on house rooftops to generate power, which can reduce power purchased from the utility and supplement the grid through sales of excess electricity to the utility. Photovoltaics may also be installed by utility companies for use as central power generating stations.

10.7.2 Energy from Biomass

Biomass fuels are energy sources from recent-term organic (plant and animal) matter. Examples of biomass sources are trees, farm crops (such as ethanol from corn), manure, plants and landfill gas. While wood is one of the most plentiful forms of biomass energy, trees can take from 10 to 20 years to become large enough to use – making sound forestry management essential to the viability of this resource. Wood waste (sawdust, shavings, bark and black liquor) can also be used to generate electricity. The largest source of energy from wood is pulping liquor or "black liquor," a waste product from processes of the pulp, paper and paperboard industry.

Grain crops such as corn and wheat can be processed into alcohol fuels. Ethanol is an alcohol-based alternative fuel produced by fermenting and distilling starch crops that have been converted into simple sugars. Feedstocks for ethanol include corn, barley and wheat, and bioethanol can also be produced from "cellulosic biomass" such as trees and grasses. Ethanol is most commonly used to increase octane

and improve the emissions quality of gasoline. Most major automobile manufacturers produce at least one vehicle that is capable of running on a mixture of ethanol and gasoline.

Biodiesel is a renewable fuel that can be used in place of diesel fuel. Biodiesel can be made from vegetable oils, animal fats, or greases, with most biodiesel made from soybean oil. Approximately half of biodiesel producers are able to manufacture biodiesel from used oils or fats, including recycled restaurant grease. Biodiesel is most often blended with petroleum diesel, but can also be used in its pure form. Biodiesel fuels can be used in regular diesel vehicles without making any changes to the engines. It can also be stored and transported using diesel tanks and equipment. Because it is so clean-burning and easy to use, biodiesel is the fastest growing and most cost efficient fuel for fleet vehicles, including school buses, garbage trucks, mail trucks and military vehicles. Although the use of biodiesel has been primarily limited to fleets of vehicles that have their own fueling stations, it may become more popular with individual consumers as the number of public fueling stations that offer biodiesel grows. Biodiesel could present a viable fuel option for larger public and private organizations with substantial vehicle fleets, particularly if locally produced oils and greases can be recycled for this purpose.

The methane gas derived from animal and human waste using an anaerobic digester is another viable and attractive fuel source. Methane gas can be used either in an internal combustion engine to produce electricity or to assist in co-firing a boiler or heat exchanger system. In some instances the gas is bottled and used to fuel farm equipment. Municipal solid waste (MSW) landfills are also promising sources of methane. The EIA reports that each person in the United States generates almost a ton of waste per year, most of which is deposited in solid waste landfills. Landfill gas (LFG) is created when waste in a landfill decomposes. Instead of allowing landfill gas to escape into the air, the gas can be captured, converted, and used as an energy source. The recovered methane can be used to fire industrial boilers, heat and cool residential and industrial spaces, fuel gas and steam engines, power fuel cells, and to power vehicles through conversion to either methanol or diesel fuel.

Greenwood County has entered into a 10-year agreement to sell methane gas rights from the Greenwood County Landfill to Methane Power, Inc. Methane Power captures, converts, and sells the methane gas from the landfill to FUJIFILM Manufacturing USA, Inc. to fire boilers at its manufacturing complex in Greenwood County. Approximately 40% of the plant operations are powered by the methane gas captured at the landfill. FUJIFILM originally planned to use at least 197 Btu's of energy from the landfill each year, which equates to the amount of energy needed to provide annual heating for more than 5,000 homes. However, energy production from the landfill has by far exceeded that target and is currently providing 140,000 MMBtu of energy to FUJIFILM each year, with a rate of delivery that continues to increase over time.

10.7.3 Geothermal Energy

Geothermal energy is the heat from beneath the Earth's surface, with resources ranging from shallow ground to hot water and hot rock found a few miles beneath the Earth's surface. In South Carolina, geothermal heat pumps (GHP) that require only moderate ground temperatures use the earth's moderate, relatively constant temperature (ranging from 60ºF to 70ºF) to provide year round heating and cooling. Geothermal heat pumps are among the most efficient and comfortable heating and cooling technologies available, requiring no supplemental heat source because of the moderate temperature of the ground even in winter. According to the SCEO, the energy value of the heat removed is usually more than three to four times the electricity used in the transfer process.

A GHP system consists of a heat pump, an air delivery system (ductwork), and a heat exchanger consisting of a system of pipes buried in the ground near the building. Most systems in South Carolina are vertical loop installations with a typical depth of 200 feet. In the winter, the heat pump removes heat from the heat exchanger and pumps it into the indoor air delivery system. In the summer, the process is reversed, and the heat pump moves heat from the indoor air into the heat exchanger. The heat removed from the indoor air during the summer can also be used to heat water, providing a free source of hot water.

10.7.4 Thermal Energy Storage

Thermal energy storage systems save energy and money, as well as conserve resources through the filtration and reuse of the water used in the systems. Ice has long been used for space comfort conditioning. Modern thermal storage systems utilize mechanical refrigeration (called chillers) to make ice at times when electric rates are lower – primarily at night. The ice is stored and as cooling is needed water is circulated through the ice storage area and then distributed to provide space cooling. Thermal energy storage supplements and in some instances even replaces mechanical cooling during the day when utility rates are at their highest. Depending on the situation and type of installation, ice storage can cut electric costs dramatically. Ice storage has the potential to reduce both system demand and overall energy costs for many types of structures including large buildings and public facilities. An additional advantage of ice storage is the standby cooling capacity available if the chiller is unable to operate for any reason. In those cases one or two days of ice may still be available to provide cooling until the chiller is operational once again.

Goals, Objectives, and Strategies for Implementation

Goals/Objectives/Strategies	Accountable Agency	Time Frame for Completion
Goal 10.1. – Promote energy conservation through environmentally beneficial actions		
Objective 10.1.1. Encourage the use of trees and landscaping to conserve energy		
Strategy 10.1.1.1. Encourage the use of trees and landscaping to conserve energy.	Planning Commission	On-going
Strategy 10.1.1.2. Work with civic groups to educate the public on the energy benefits of trees, landscaping and proper maintenance.	SC Forestry Commission	On-going
Strategy 10.1.1.3. Continue to use services of urban foresters.	City of Greenwood	On-going
Strategy 10.1.1.4. Work with civic groups to plant trees and other vegetation in developed areas.	Forestry Commission	On-going
Objective 10.1.2. Provide and encourage open spaces		
Strategy 10.1.2.1. Revise development standards to encourage developers to link new open spaces and greenways to existing greenways.	Planning Commission	2011
Strategy 10.1.2.2. Develop programs to fund land purchases for greenways and seek conservation easements from property owners.	Upper Savannah Land Trust	On-going
Strategy 10.1.2.3. Designate potential open space in developed areas and seek funding for their purchase.	Parks Commission	On-going
Objective 10.1.3. Use and encourage the use of alternative fuels		
Strategy 10.1.3.1. Work with civic groups and other levels of government to promote the use of alternative fuels.	Greenwood County	On-going
Strategy 10.1.3.2. Educate the public on the availability and benefits of alternative fuels.	Greenwood County	On-going
Strategy 10.1.3.3. Incorporate the use of alternative fuels into local government and institutional operations.	EPAC	On-going
Strategy 10.1.3.4. Work with civic groups and other levels of government to seek funding such as grants or loan programs for incentive programs.	Greenwood County	On-going
Strategy 10.1.3.5. Study the potential of converting waste byproducts into energy for industrial use.	Greenwood County	2013
Strategy 10.1.3.6. Continue to measure methane production levels at the landfill as the cells are closed.	Greenwood County	On-going
Objective 10.1.4. Encourage recycling		
Strategy 10.1.4.1. Continue to work with civic groups to educate the public on the benefits of recycling.	County Recycling	On-going
Strategy 10.1.4.2. Continue to work with local businesses and industries to encourage recycling in the private sector.	County Recycling	On-going
Strategy 10.1.4.3. Continue to develop recycling centers and determine locations based on current and potential population growth.	County Public Works	On-going
Strategy 10.1.4.4. Make recycling more convenient for small businesses.	County Recycling	On-going
Goal 10.2. – Promote energy conservation through economic development		
Objective 10.2.1. Recruit and retain businesses and industries with energy conservation in mind		
Strategy 10.2.1.1. Continue consideration of local sustainability when evaluating industrial and business prospects.	Economic Alliance	On-going
Strategy 10.2.1.2. Continue to develop strategies for recruiting industries that contribute to local energy conservation efforts.	Economic Alliance	On-going

Goals/Objectives/Strategies	Accountable Agency	Time Frame for Completion
Goal 10.2. – Promote energy conservation through economic development		
Objective 10.2.2. Revitalize existing facilities and districts and promote infill development		
Strategy 10.2.2.1. Continue to focus economic development efforts on the reuse of existing properties and the use of infill properties.	Economic Alliance	On-going
Strategy 10.2.2.2. Continue to develop detailed inventories of vacant, underutilized and available commercial and industrial properties.	Economic Alliance	On-going
Strategy 10.2.2.3. Continue to develop incentives to locating in existing facilities on infill properties such as tax or fee reductions.	Economic Alliance	On-going
Strategy 10.2.2.4. Continue to work with local developers, realtors and economic developers to develop promotional materials for revitalization.	Economic Alliance	On-going
Strategy 10.2.2.5. Continue to seek funding to support brownfield reclamation efforts.	Economic Alliance	On-going
Strategy 10.2.2.6. Continue to work with economic developers to develop promotional materials on successful brownfield redevelopments.	Economic Alliance	On-going
Strategy 10.2.2.7. Continue to facilitate regulatory flexibility in redevelopment.	Planning Commission	On-going
Objective 10.2.3. Promote the production of economically valuable good and services		
Strategy 10.2.3.1. Encourage the development of industrial parks that reduce waste, promote recycling and energy efficiency, and have a minimal impact on the environment.	Economic Alliance	On-going
Objective 10.2.4. Encourage the use of renewable energy and recycling in business and industry		
Strategy 10.2.4.1. Facilitate the development of partnerships to encourage the use of renewable energy sources.	Greater Greenwood Chamber of Commerce	On-going
Strategy 10.2.4.2. Seek funding for the implementation of renewable resource programs.	Greenwood County	On-going
Strategy 10.2.4.3. Facilitate local and regional eco-industrial recycling partnerships for waste by-product incorporation into industrial production processes and energy generation.	Greenwood County	On-going
Objective 10.2.5. Encourage incorporation of energy conservation measures into construction and design		
Strategy 10.2.5.1. Assist businesses and industry with identification of funding assistance for upgrades, retrofits, and new technology demonstration.	Economic Alliance	On-going
Strategy 10.2.5.2. Educate employers on Long-Term savings from energy efficient investments.	Greater Greenwood Chamber of Commerce	2011
Strategy 10.2.5.3. Establish partnerships with local utilities to develop energy efficiency and conservation programs.	CPW/Duke Energy	2012
Strategy 10.2.5.4. Sponsor workshops on energy conservation practices and conduct energy audits for commercial and industrial facilities.	CPW/Duke Energy	2012
Strategy 10.2.5.5. Partner with employers and utility providers to build demonstration facilities to showcase energy-efficient design principles.	CPW/Duke Energy	2013
Objective 10.2.6. Promote energy conservation in the regulation process and provide incentives for conservation		
Strategy 10.2.6.1. Streamline development standards and approval processes and allow flexibility for new technologies and innovations.	Planning Commission	On-going
Strategy 10.2.6.2. Link economic development efforts with the goals and objectives of the Comprehensive Plan.	Planning Commission	On-going
Strategy 10.2.6.3. Coordinate closely with economic developers in planning and development matters.	Planning Commission	On-going

Goals/Objectives/Strategies	Accountable Agency	Time Frame for Completion
Goal 10.2. – Promote energy conservation through economic development		
Objective 10.2.6. Promote energy conservation in the regulation process and provide incentives for conservation		
Strategy 10.2.6.4. Pursue federal and state funding opportunities for pilot projects and development of new energy technologies and products.	Lander University/Piedmont Technical College	On-going
Strategy 10.2.6.5. Involve local business and industry representatives in the energy conservation planning process.	EPAC	On-going
Strategy 10.2.6.6. Identify and secure tax breaks, loans, financing, infrastructure grants and other incentives for energy conservation.	Greenwood County	On-going
Goal 10.3. – Reduce residential energy use		
Objective 10.3.1. Promote energy conservation through housing design, materials and landscaping		
Strategy 10.3.1.1. Continue to work with local civic groups and utilities to seek funding for weatherization programs and to educate the public on benefits of making homes more energy efficient.	Upper Savannah COG	On-going
Strategy 10.3.1.2. Continue to work with the building industry to educate their members about the benefits of energy efficient development and construction.	City/County Building Inspection	On-going
Strategy 10.3.1.3. Continue to work with local civic groups and utilities to educate the public on the benefits on energy efficient heating and cooling units, water heaters, and other appliances.	City/County Building Inspection	On-going
Strategy 10.3.1.4. Promote Duke Energy's Home Energy Analysis Program as a way for homeowners to conserve energy.	City/County Building Inspection	2011
Goal 10.4. – Reduce energy used in community facilities		
Objective 10.4.1. Promote energy conservation through administrative procedures, policy changes and education		
Strategy 10.4.1.1. Develop and implement a comprehensive energy conservation program.	Greenwood County	On-going
Objective 10.4.2. Consider energy conservation when determining the location of new facilities		
Strategy 10.4.2.1. When possible, locate new facilities near bicycle and pedestrian facilities.	Greenwood City/County Planning Department	On-going
Strategy 10.4.2.2. When possible, locate new facilities near related uses and essential services such as childcare, restaurants, etc.	Greenwood City/County Planning Department	On-going
Strategy 10.4.2.3. Work with school districts and other state and federal agencies to encourage compliance with local development and construction requirements.	Planning Commission	On-going
Strategy 10.4.2.4. Work with school districts and other state and federal agencies to encourage consideration of energy use impacts when siting new facilities.	Planning Commission	On-going
Goal 10.5. – Reduce energy used for transportation		
Objective 10.5.1. Reduce energy use through street and parking design		
Strategy 10.5.1.1. Revise development standards to size street widths relative to their use and to allow smaller turnaround radii.	Planning Commission	2011
Strategy 10.5.1.2. Encourage connected street systems within and between developments.	Planning Commission	2011
Strategy 10.5.1.3. Encourage pedestrian protection measures at intersections.	Planning Commission	2011
Strategy 10.5.1.4. Discourage the use of cul-de-sacs in developments.	Planning Commission	2011
Strategy 10.5.1.5. Include provisions for safe and convenient pedestrian and bicycle travel in street and parking design standards.	Planning Commission	2011
Strategy 10.5.1.6. Encourage connection between parking areas within adjacent development when possible.	Planning Commission	2011

Goals/Objectives/Strategies	Accountable Agency	Time Frame for Completion
Goal 10.5. – Reduce energy used for transportation		
Objective 10.5.2. Provide a multi-modal transportation system		
Strategy 10.5.2.1. Encourage integration of alternative modes of transportation in new developments.	Planning Commission	2011
Strategy 10.5.2.2. Include provisions for safe, convenient and attractive pedestrian and bicycle paths in all new developments.	Planning Commission	2011
Strategy 10.5.2.3. Encourage new development to include pedestrian and bicycle paths that connect to existing developments and destinations.	Planning Commission	2011
Strategy 10.5.2.4. Encourage the continued study by regional and local governmental entities of the need for a transit system and evaluate transit as an alternative mode within the long range transportation plan.	Upper Savannah COG	On-going
Strategy 10.5.2.5. Study the feasibility of adding a ride share facility for residents that travel outside of the County for employment.	Upper Savannah COG	2012
Goal 10.6. – Conserve energy through land use planning		
Objective 10.6.1. Encourage mixed use development		
Strategy 10.6.1.1. Allow accessory housing units.	Planning Commission	2012
Strategy 10.6.1.2. Develop incentives for the inclusion of pedestrian and bicycle paths linking destinations within mixed-use developments and adjacent areas.	Planning Commission	2011
Strategy 10.6.1.3. Streamline review and variance procedures.	Planning Department Staff	2012
Objective 10.6.2. Encourage infill and redevelopment		
Strategy 10.6.2.1. Revise development standards to allow infill and redevelopment as a permitted use whenever possible.	Planning Commission	On-going
Objective 10.6.3. Encourage compact development and clustering		
Strategy 10.6.3.1. Promote the use of compact development and clustering incentives whenever possible.	Planning Commission	On-going
Strategy 10.6.3.2. Incorporate flexible design standards.	Planning Commission	On-going
Strategy 10.6.3.3. Provide tax incentives and fee reductions to developers of compact or cluster development projects.	Greenwood County	2015

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